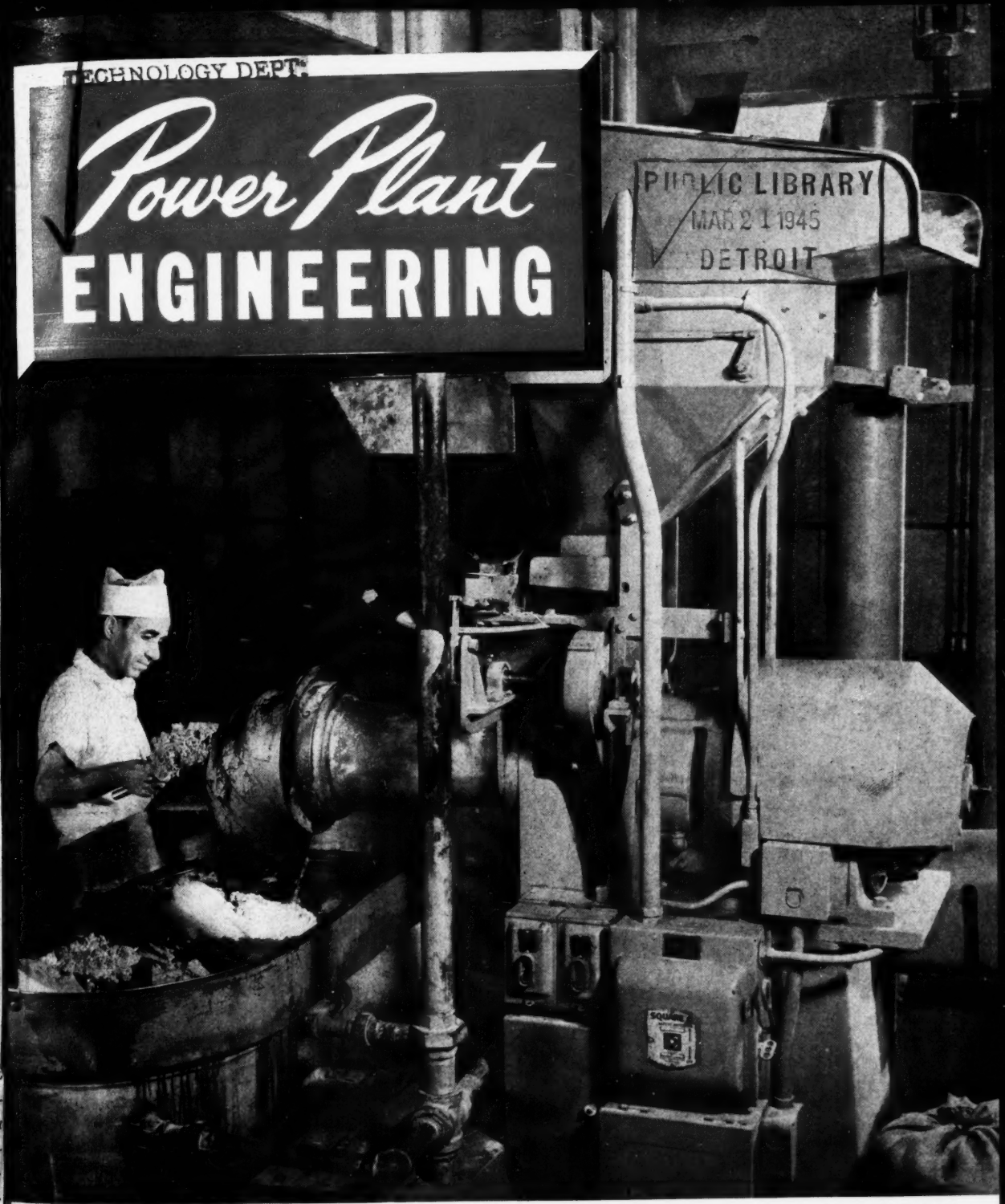
TECHNOLOGY DEPT.

Power Plant ENGINEERING

PUBLIC LIBRARY
MAR 21 1945
DETROIT



THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

MARCH • 1945

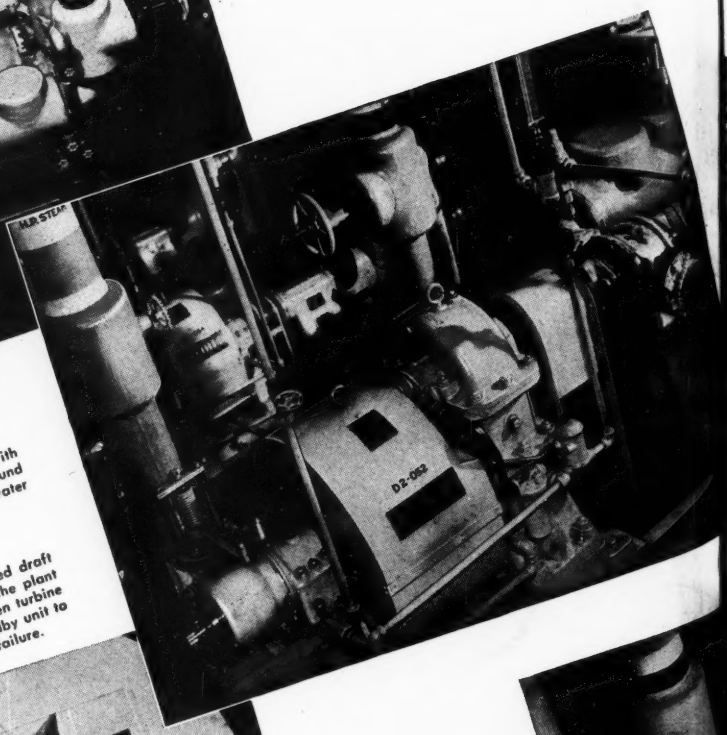
Features

POWERING THE RIVER WORKS OF G-E FOR WAR PRODUCTION • WHAT THE ENGINEER SHOULD KNOW ABOUT SERIES CAPACITORS • MODERN EXTRACTION TURBINES, PART 3 • THE CHIEF DON'T KNOW NOTHING ABOUT ENGINES • TRANSFORMER TANK CLEANING

CONTENTS PAGE 5

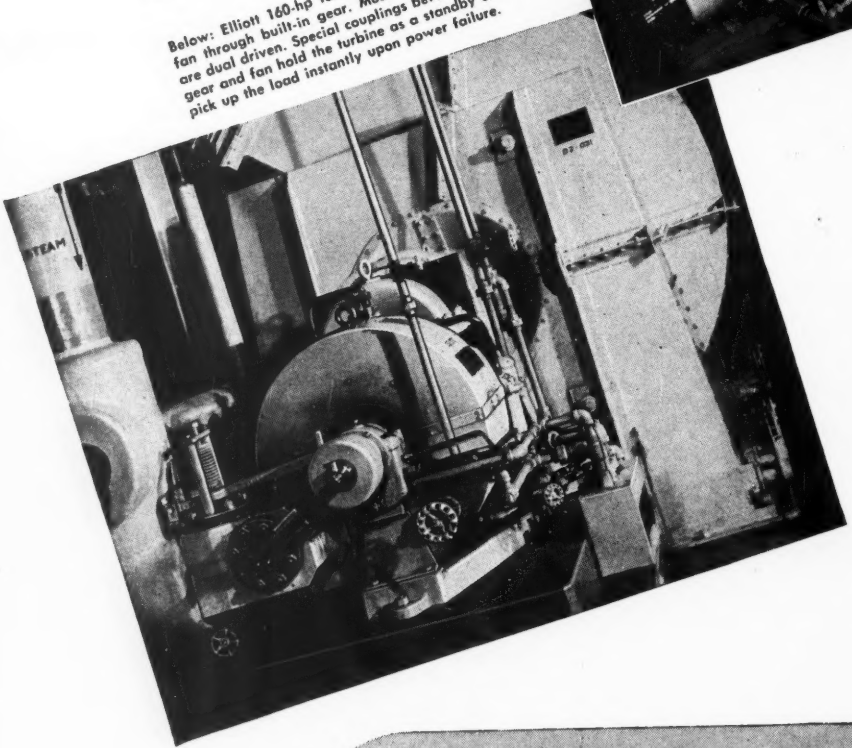
"to insure co

Above: Elliott 250-hp turbine with built-in gear driving circulating water pump.



At right: In foreground Elliott 25-hp turbine with built-in gear driving fuel oil pump. In background an Elliott 20-hp turbine for a treated water make-up pump

Below: Elliott 160-hp turbine driving forced draft fan through built-in gear. Most fans in the plant are dual driven. Special couplings between turbine gear and fan hold the turbine as a standby unit to pick up the load instantly upon power failure.



ELLIOTT

"continuous service"*

at the steam plant of Kaiser Company Inc.

Elliott 400-hp turbine driving induced draft fan. Turbine speed is reduced to fan speed by horizontally offset coupled gear.

It took a war to do it—to call into being America's vast, hidden capabilities in manufacturing and ship building. The iron and steel plant of Kaiser Company, Inc., Fontana, Calif., is a famous example.

To build ships they needed steel plate. To make plate they built a steel plant. Built it fast — but carefully, served by selected and proven equipment . . . such as the nineteen Elliott mechanical drive turbines which power the steam plant auxiliaries and various pumps in the by-products plant. These are units that must keep going — and they do, with characteristic Elliott reliability. You might say the plant depends upon their faithful operation, and in a number of the drive functions it does.

Elliott mechanical drive turbines are selected for so many critical drive jobs that their sure performance has become almost traditional.

Built in several types, and supplied when required with built-in reduction gears. Full details in the descriptive bulletins, sent on request.

**Quoted from an interesting descriptive article on the Kaiser Company's steam plant, by Mr. H. H. Hyde, project engineer, Bechtel-McCone-Parsons Corporation, and to be published in the Spring issue of POWERFAX. Copy on request.*

H-889

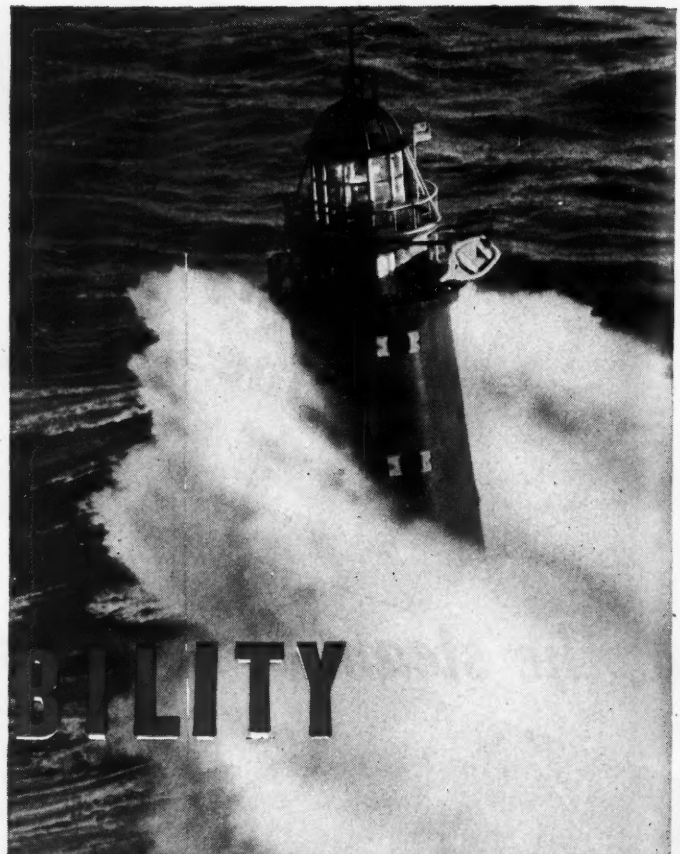
Company

Steam Turbine Dept., JEANNETTE, PA.

DISTRICT OFFICES IN PRINCIPAL CITIES

STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

Symbol of DEPENDABILITY



FOR OVER three-quarters of a century the 114-foot Minot's Ledge Light has stood, a symbol of dependability, guiding mariners through outer Boston Harbor.

Like the lighthouse, the Diesel has, by its outstanding performance, earned a similar reputation for dependability everywhere in the field of power generation. And wherever they are used . . . on land and sea, in stationary plants and mobile equipment . . . Diesels operate more efficiently, more dependably, when lubricated with Texaco Ursa Diesel lubricants.

Texaco Ursa Diesel lubricants constitute a complete line of Diesel lubricants. There is one to meet the lubrication requirements of every type of Diesel engine. They increase the life of rings, pistons, liners and bearings by preventing scuffing, ring-sticking, sludge and corrosion. Because of these benefits—

More stationary Diesel hp. in the U.S. is lubricated with Texaco than with any other brand.

A Texaco Lubrication Engineer, specializing in Diesel lubrication, will gladly recommend the most suitable type and grade of Texaco Ursa Diesel lubricant for your engine. Phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Lubricants and Fuels

FOR ALL DIESEL ENGINES

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON SUNDAY NIGHTS ★ METROPOLITAN OPERA BROADCASTS SATURDAY AFTERNOONS

EDITORIAL STAFF

ARTHUR L. RICE
Editorial Director

RALPH E. TURNER
Editor

ANDREW W. KRAMER
Managing Editor

CHESTER R. EARLE
Associate Editor

RICHARD H. MORRIS
Engineering Editor
On leave with U. S. Army Air Forces

Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

KINGSLEY L. RICE, *President*
EDWIN C. PROUTY, *Vice President*
WALTER PAINTER, *Vice President*
ARTHUR L. RICE, *Treasurer*
CHARLES S. CLARKE, *Secretary*
JOHN O. AARVOLD, *Prod. Mgr.*

ADVERTISING REPRESENTATIVES

CHICAGO: Charles S. Clarke
53 W. Jackson Blvd., Chicago 4, Ill.
Harrison 0824

NEW YORK: John A. Kershaw
Graybar Bldg., New York 17, N. Y.
Caledonia 5-3779

PHILADELPHIA: H. G. Wilds
121 Waverly Road, Wyncote, Pa.
Ogontz 1066

CLEVELAND: A. H. Van Duyn
627 Union Commerce Bldg.
Cleveland 14, Ohio
Cherry 1377

PACIFIC COAST: Roy M. McDonald Co.
San Francisco: Roy M. McDonald, *Mgr.*
564 Market St.
San Francisco 4, Calif.
Garfield 8966

Los Angeles: Milo D. Pugh, *Mgr.*
541 S. Spring St.
Los Angeles 13, Calif.
Tucker 7981

WASHINGTON, D. C., NEWS OFFICE
Business News Service
10 Independence Ave.

By Subscription Only
One year $2.00; two years $3.00; three years $4.00, in the United States and Possessions

Power Plant ENGINEERING

March 1945

VOLUME 49 — NUMBER 3

Cover: Photo of peanut butter mill illustrates varied power service applications in a modern candy factory. Grinder is driven by 15 hp motor; two 2 hp motors work mixing blades; peanut elevator at right uses ½ hp motor; jacket of 5 lb steam keeps peanut butter at right consistency.

Front Lines 7

What Leaders Say 71

Mobile Plant at Mare Island 72

With the Editors 73

Power for G-E War Production at Lynn—*By A. T. Comstock* 74

Kentucky Dam Project of TVA—Part II—
By C. L. Norris and R. M. Gardner 79

Modern Extraction Turbines—Part III—*By L. E. Newman* 82

AIEE Meeting Marks Steady Progress of Mechanical Engineering 87

Centrifugal Pump Control—Part IV—*By Igor J. Karassik* 90

Series Capacitor Installations For Industrial Power Systems—
By W. C. Bloomquist 94

U. S. Boilers Inadequate 98

Transformers Chemically Cleaned—*By Vincent E. Bowes* 98

When Flow Meters Err Check Installation—*By Louis Gess* 100

The Practical Engineer and Electrician 101

Simplified Practice for Pipes, Ducts, and Fittings 128

Possibilities of the Pressurized Boiler Furnace—*By A. G. Christie* 130

New Equipment 144

Obituaries 164

Manufacturers' News 168

Manufacturers' Personals 172

News From the Field 176

New Engineering Books 180

Construction News 200

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

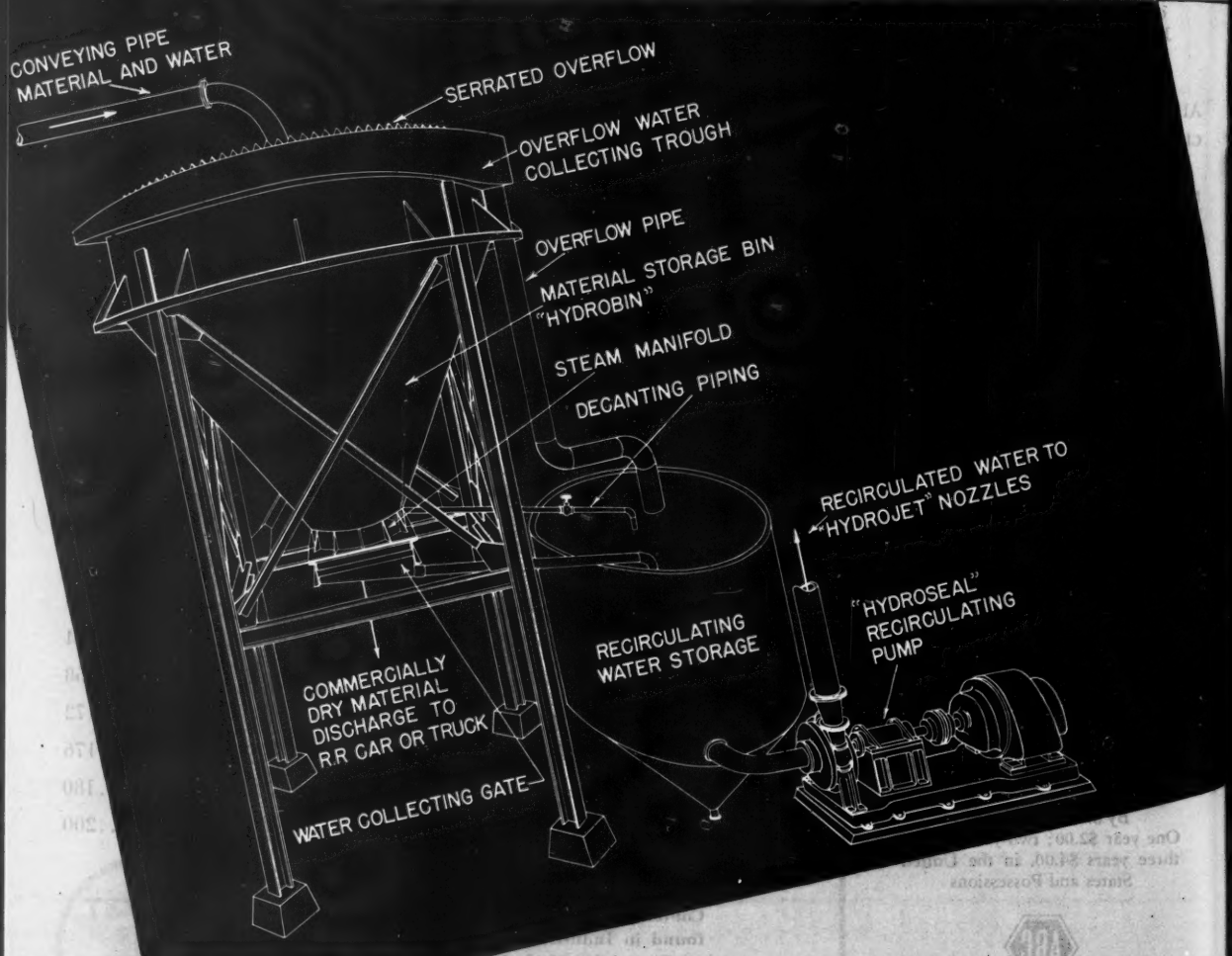
Copyright, 1945, by Technical Publishing Company.

Published monthly by the Technical Publishing Co., at 53 West Jackson Blvd., Chicago 4, Ill., U. S. A.. Subscription price, $2.00 a year. Entered as second class matter September 8, 1932, at the Post Office, Chicago, Ill., under act of March 3, 1879. Vol. XLIX, No. 3.

Ashes Pumped WET—Delivered DRY

Ash and dust laden water enters the Hydro-Bin at the top; the water being removed by the overflow trough at the top, decanting elements at the sides and a water collecting gate at the bottom of the bin. Commercially dry refuse remains in the bin, for unloading into cars or trucks. Water removed from the bin can pass into a sewer or it may go to a storage tank, as illustrated, for recirculation through the Hydrojet System of Ash Removal or the Hydrovac System of Dust Removal. Hydroseal Pumps are used for pumping refuse into the bin and for recirculation of water. . . . The Dewatering Hydro-Bin is equipped with a steam manifold around the discharge gate, to insure operation in sub-freezing temperatures. Our nearest representative will gladly give you full information about this and other methods of refuse disposal available where Hydrojet and Hydrovac Systems are used.

Dewatering HYDRO-BIN



ALLEN-SHERMAN-HOFF CO., 233 S. 15th St., PHILADELPHIA 2, PA. Offices & Representatives in Principal Cities

Front Lines

CYCLODIENE FN, an all-purpose solvent metal degreaser and cleaner just announced by the Technical Processes Division of the Colonial Alloys Co., Philadelphia 29, Pa., in addition to its high speed of solvency, contains a finger print and body acid neutralizer. Even the most carefully cleaned and handled work, going through various routing and shop operations prior to final finishing, picks up finger marks, most of which are acidic. Most humans are on the acid side. This acid, if not quickly neutralized, oxidizes the metal surfaces long before the finishing operation is reached. Too often the finish is blamed, when the trouble really centers on proper cleaning and neutralization of the metal surfaces. Used at room temperature, the work is immersed into or sprayed with Cyclodiene FN. No special equipment is required.

EVIDENCE that a high explosive shell inflates to twice its normal diameter just before it appears to burst open inside a steel plate and that the blast which accompanies the firing of a rifle bullet sometimes will beat the missile to the muzzle was disclosed by Dr. Charles M. Slack at a recent meeting of the Cleveland section of the American Industrial Radium and X-Ray Society.

Photographs proving these facts and adding other new knowledge to the science of ballistics have been made at the Army's Frankford Arsenal in Philadelphia with equipment containing an X-ray tube which takes pictures in a millionth of a second. Dr. Slack, assistant research director for the Westinghouse Lamp Division at Bloomfield, N. J., developed the tube. "This same procedure," Dr. Slack observed, "can be used to study the action of the component parts of valves or other machinery during operation . . . and in studying the rapid metallurgical changes which take place during arc welding operations. For the study of rapidly-moving machine parts such as automobile parts, Dr. Slack said, "We no longer will have to wait until those parts have performed to see what causes unnecessary wear and failure. With the help of the high-speed X-ray camera we can watch those parts tick while they are ticking."

A TURBOSUPERCHARGER with a top-ranking operational record of functioning flawlessly on 102 Flying Fortress bombing missions against German industrial and military targets was presented Jan. 19 as a Christmas gift from the 381st Bombardment Group of the Eighth Air Force in England to Dr. Sanford A. Moss, inventor of the turbosupercharger, at the Lynn (Mass.) River Works of General Electric Co.

"Although the grueling demands of high-altitude combat flying wear out the average good turbo around 500 hr., this turbo apparently is as sound in its 1,004th hour as in its first," an AAF sergeant in England, who studied the long battle log of the B-17 on which this champion supercharger functioned, said in a report made public at the ceremony,

FULL STRENGTH AT 1650 F.—Jet propulsion and gas turbine for airplanes depend for success on metals that will maintain a high strength at bright red heat. K-42-B, developed by Westinghouse, is a high-temperature alloy of the forgeable type.

BASIC PATENTS covering electronic vulcanization of rubber and other materials have been purchased by The B. F. Goodrich Co. and The Firestone Tire & Rubber Co. The patents were originally granted on discoveries made by R. A. Dufour and H. A. Leduc of France, and by E. E. W. Kassner of Switzerland. The rubber companies have stated that the patents would be made available both to the rubber and plastics industries on a reasonable basis, believing that this policy will speed electronic development, ultimately making available to consumers improved rubber and plastics products at lower costs. In electronic vulcanization, high frequency oscillations shake the molecules of rubber and sulphur millions of times a second, creating uniform heat throughout the product being vulcanized in a fraction of the time required when steam is used. The same uniform heating removes difficulties in the molding of thick plastic products. Electronic heating also makes possible the use of simplified equipment.

IF A STUDENT in an engineering school intends to enter the Diesel engine industry, just what sort of training should he have? And if he does enter the industry, what are his opportunities there? A folder just issued by Diesel Engine Manufacturers Association, 1 No. La Salle St., Chicago, Ill., answers these and other questions. Titled "What Are the Opportunities for College Men in the Diesel Engine Industry?" the folder points to jobs in Diesel engine factories in production, installation, maintenance and sales. Out in the field there is "interesting work" in Diesel operation in "railroads, ships, stationary power plants, busses and trucks". Jobs for designers and in the research field will, for the most part, be open to engineers with master's and doctor's degrees, the folder states. Best training to equip a graduate engineer for entering the Diesel industry consists of "a well-grounded course in the fundamentals of mechanical engineering".

GENERAL MOTORS CORP. HAS REVEALED that since the beginning of the defense program in 1940 it has produced more than: 140,000,000 shells and shell casings; 180,000 cannon; 1,000,000 .30 and .50-caliber machine guns; 2,400,000 carbines; 180,000 airplane engines; 9,000 complete bombers and fighter planes; 31,000 tanks, tank destroyers and armored cars; 740,000 trucks, including amphibious "Ducks"; a major part of all the Diesel engines produced for the United States on land and sea.

ARE YOU a protanope or a deuteranope? If so, then you are one of two types of unfortunate persons who have red-green color blindness. About 2 per cent of otherwise normal males have this trouble. To about half of these, red signals not only fail to appear red but also have less than one-fifth normal brightness. These are the protanopes. The others, to whom red signals are normally bright, even when they don't look red, are the deuteranopes. If your best friend won't tell you, get in touch with the National Bureau of Standards, Washington, D. C., which has been working with the Army and Navy through the committees of the Inter-Society Color Council, to develop procedures for placing soldiers and sailors who may have defective color vision where this defect will not be a handicap.

OF ALL the war time shortages under which the American public is bearing up manfully, one at least is already beginning to produce a most pleasing and beneficial result. That is the shortage of conventions. As a matter of fact, it was possible the other day for one of the local newspapers to announce for the first time in a great many years there were absolutely no conventions in Chicago on that day. A few days later the grapevine had it that one of the very largest hotels and several of the smaller ones had a great many vacant rooms. The effect of no conventions has also been apparent in some of the city's more popular restaurants. Apparently it is none too easy to answer the question "How would the progress of the war be hampered if this convention were not held?" O-course, one result has been a boom in the public relaf tions industry in order to explain in mimeographed form that the convention will not be held. Another result has been that the officers of a good many organizations usually elected at annual conventions will have to stay in office until the next convention can be held. This, of course, causes considerable heart burning, thus increasing the demand for various forms of effervescent salts, medicated chewing gum and various forms of pills devoted to the reduction of excess stomach acidity. Well, as Emerson said in stating his well known law of compensation, "You can have anything you want provided you are willing to pay the price for it."

SAND, in its natural state the cause of millions of dollars worth of damage to electrical equipment, has been combined with coal, brine and oil to create materials called silicones to which we first called attention in Front Lines, September, 1929, page 8. These silicones are destined to make the most valuable contributions to electrical insulating procedures in years, engineers attending the mid-winter meeting of the AIEE were told recently. G. L. Moses, section engineer of the Westinghouse Electric and Manufacturing Co., and T. A. Kauppi, manager of product engineering for the Dow Corning Corp., explained how the gritty product of American beaches has been chemically treated to become: a vital component of soft grease that neither harden to −40 degrees nor melt at 400 F.; an intrinsic part of fluids with similar properties, yet as thin as water; and a basic ingredient of resins and varnishes which, when used as insulation, stand up under tremendous heat.

KEEPING TECHNICAL MANPOWER available in the laboratories is vital at this stage of the war, according to the report of Earl P. Stevenson, President, at the annual meeting of Arthur D. Little, Inc., Cambridge, industrial research organization. Mr. Stevenson cited a recent emergency in which a front-line observer was flown back to the United States with information on a new enemy defense tactic. Because techoical manpower could be immediately concentrated on the problem, a promising counter-measure device was quickly developed. Mr. Stevenson pointed out that such problems will continue to arise and demand the kind of attention that only existing, competently staffed organizations can render.

A RIVER FLOWS THROUGH A SHIP—An army moves on its stomach, but the Navy moves on electrical energy. With its peacetime "know-how," Westinghouse has produced propulsion turbines for all kinds of ships. These propulsion turbines provide more than 200,000 hp per ship, or enough electrical energy to supply the needs of a city of 500,000. Condensers on one battleship circulate as much water through themselves as flows through a medium-sized river.

THAT MAN with the wrench for the third time. Those two items published in the February and June 1944 Front Lines, commenting on the proper tightening of bolts and nuts, aroused a flurry of interest among readers such as we have not seen for a long time. Certainly the subject of proper tightening of bolts and nuts is vital to all engineers and particularly to power engineers who have so much equipment that still has to be bolted despite all the present day applications of welding. We referred also to the very fine paper by J. O. Almen of General Motors Research Corp. on the subject of bolting published in No. 1 and 2, Vol. 1, of Fasteners. Now in the latest issue of Fasteners, Vol. 1, No. 4, we find interesting discussion of another phase of the bolting subject. In an article entitled, What Torque?, W. C. Stewart discusses in detail how to calculate a torque required to produce a desired initial tension in bolt or screw shanks. The most common method of setting tension in bolt or screw shanks is by use of a torque wrench. Mr. Stewart says that the discussion is prepared in response to a tremendous number of requests for information about it. Since the paper has already been published in Fasteners, we do not propose to duplicate it here. But to make it as easy as possible to get it if you are interested, we suggest you write to The American Institute of Bolt, Nut and Rivet Manufacturers, 1550 Hanna Bldg., Cleveland 15, Ohio.

MAINTENANCE of waterwheels, shafts and various submerged structures in hydro-electric plants often produces some difficult problems and some ingenious solutions of them. The use of the metallizing process in this work is discussed in several interesting items in the November-December, 1944 issue of Metco News, published by Metallizing Engineering Co., Inc., Long Island City, N. Y. Detailed description is given of the repair of a badly-corroded headgate at the plant of the Shawinigan Water & Power Co. in Quebec, also of how collars for bearing liners on a 35,000-hp hydro-electric turbine were repaired. Another article describes the use of metallizing on two 1350-hp hydraulic turbine runners at the plant of the Electric Department at Rochester, Minn. It is calculated that the metallizing repair in this case saved $4000 per wheel, as compared with the cost of replacing the wheels.

TO ASSURE quality and performance of the photographic flash lamps used extensively by the Armed Forces in picture making, The American Standards Association has completed a War Standard Specification for Photographic Flash Lamps which outlines a general procedure of evaluating these lamps on the basis of picture taking ability. This is a new approach to the problem of checking flash lamp characteristics, and it is used for the first time in these specifications. Doubtless it will have a most important effect on the construction and use of such lamps by civilians after the war. Complete details can be obtained from American Standards Association, 70 East 45th Street, New York 17, N. Y.

A SQUARE MILK BOTTLE, developed by streamlining in reverse, is finding unexpected popularity for various reasons, according to an AP dispatch from Albany, N. Y. It is reported they save space, benefit the dairyman, have consumer preference, and involve no extra expense. One customer reports that her husband likes the new bottle because "it makes more room in the ice box for the beer". Our engineer friend Ambitious Al, who, incidentally, does *not* operate a brewery power plant, says that is probably the highest recommendation that any milk bottle could possibly have.

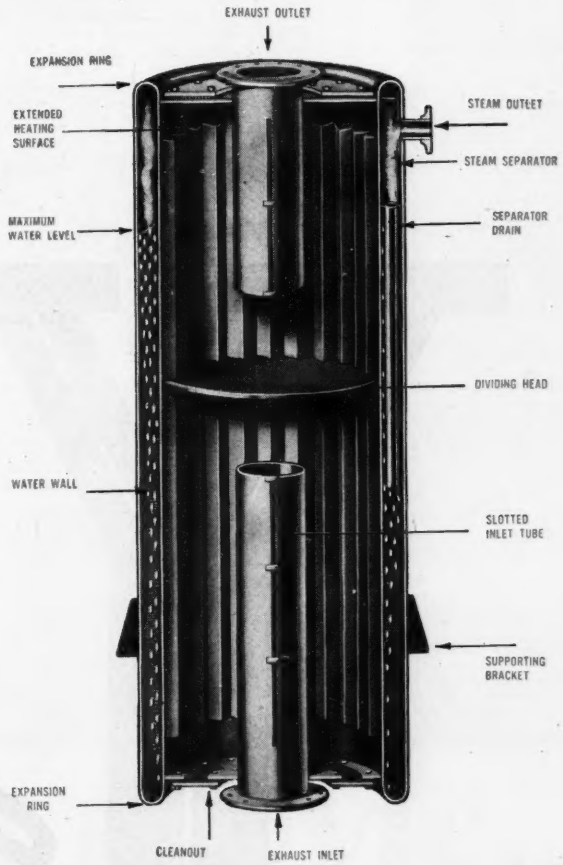
HOW TO PUT WASTE HEAT TO WORK

WITH MAXIM HEAT RECOVERY SILENCERS

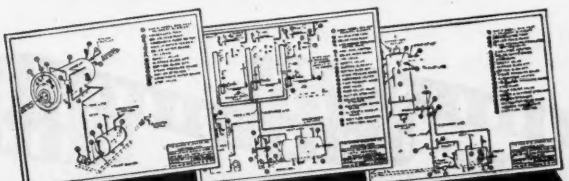
Engine exhaust heat, all too often wasted, can be put to good and profitable use through Maxim Heat Recovery Silencers. With these specially constructed silencers extra steam or hot water for heating or processing operations is obtained *without extra fuel cost* as the heat source is simply engine exhaust heat. Thus in one unit effective exhaust silencing, spark arresting (where necessary) and heat recovery are combined for maximum operating efficiency. Such a saving, important to your balance sheet at any time, is doubly important where fuel supplies are difficult to obtain.

The power plant below located in northern Minnesota is heated entirely through the use of Maxim Heat Recovery Silencers.

For silencing, without the heat recovery feature, Maxim makes silencers for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



PRACTICAL WORKING HOOK-UPS



The Maxim Engineering Department has prepared several drawings of typical Heat Recovery Silencer hook-ups. These are available with a detailed discussion of each hook-up. We will be glad to send them to you. Just ask for Dwgs. B-298, B-301, B-302 and B-303.

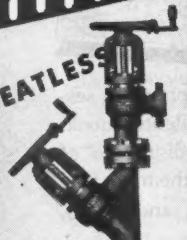
ARMY E NAVY

MAXIM

THE MAXIM SILENCER CO. • 89 HOMESTEAD AVE., HARTFORD, CONN.

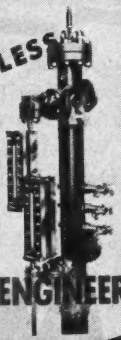
Yarway

SEATLESS



YARWAY
Seatless Blow-Off Valve

FLOATLESS



YARWAY
Floatless Hi-Lo Alarm Water Column

REMOTE

YARWAY
Remote Liquid Level Indicator

GUN-PAKT

YARWAY
Gun-Pakt Expansion Joint

IMPULSE

YARWAY
Impulse Steam Trap

"THERE IS AN ENGINEERING REASON" FOR EVERY YARWAY PRODUCT

YARWAY

makes a movie...

Lights . . . action . . . sound . . . camera!

Yarway has made a new 16 mm. color film on "*the engineering reasons*" behind familiar Yarway steam plant equipment. It is now released for showing throughout the country.

FACTUAL! This film is full of reasons why Yarway products have won universal approval from steam engineers; reasons why they will give dependable, trouble-free service in your plant, too.

FAST-MOVING! From James Watt's bobbing tea kettle lid which opens the film, to the final Parade of Yarway-Engineered Products, every foot is action-packed.

COLORFUL! Filmed in life-like Kodachrome to give clarity and realism throughout.

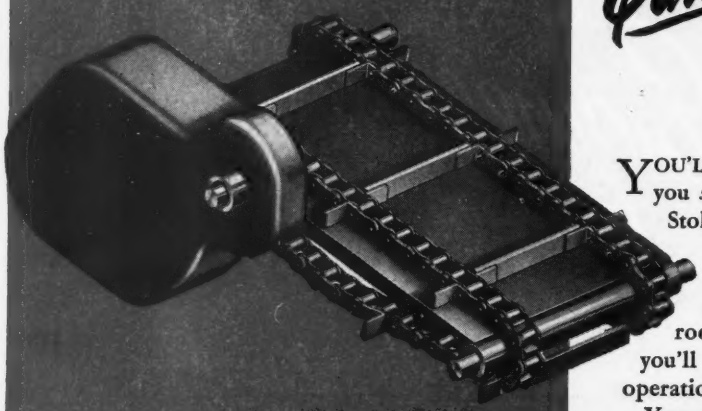
HELPFUL! Every steam user will find the scenes on product maintenance and industrial applications especially valuable.

LOWELL THOMAS COMMENTARY! The world-renowned Lowell Thomas adds crisp, accurate narration throughout.

NOW AVAILABLE! Prints are now available without cost for showing before technical societies, plant engineer groups, engineering schools and other organizations. Write on company or organization letterhead for full information today.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Phila. 18, Pa.

STEAM PLANT EQUIPMENT



ALL SPEED DRIVE GETS STEAM UP *FAST*

The Æ Perfect Spread Stoker answers steam demands instantly through a novel all-enclosed, adjustable-speed drive on the coal feeder. Automatic controls properly regulate the rate of feed and amount of forced draft to requirements—getting steam up *fast* and keeping it there!

YOU CAN HAVE *QUIET AUTOMATIC STOKING*

YOU'LL hardly believe your eyes or ears when you *see* and *hear* the new Æ Perfect Spread Stoker in operation. You'll see something entirely new and practical in stoker design. You'll see dependable, completely automatic stoking that ends boiler room drudgery and inefficient firing. And you'll be amazed at its *smooth,* unusually *quiet* operation.

You get maximum heat out of all kinds and grades of solid fuels, wet or dry, with the Æ Perfect Spread Stoker. Add to these economies the non-clogging feeder, overthrow spreading, "cross-firing" and other advantages, and you have a good idea how to produce more steam at lower cost.

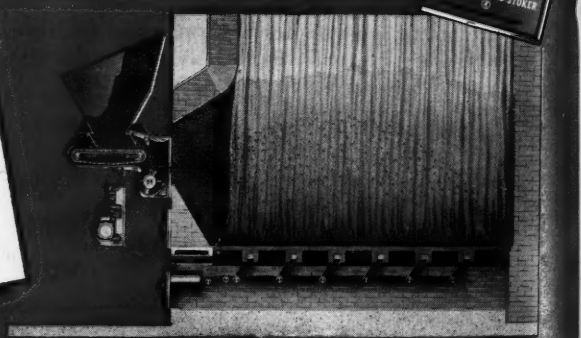
Other thrifty features and reasons why you should consider this stoker *now* are described in the new Æ Perfect Spread Stoker bulletin. Write for it today.

If Your Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.

Æ PERFECT SPREAD STOKER



Other Æ Products: Æ-Taylor Stokers, Locomotive Stokers, Marine Stokers, Underfeed Stokers, Spreader Stokers, Pulverized Fuel Systems, Pulverized Fuel Burners

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PA.

Copyright 1945, American Engineering Co.

SAFEGUARD YOUR DECISION WITH INFORMATION *NOW*

IF YOU'RE PLANNING a new stoker installation, can you afford to make a decision without knowing *all* the latest facts about *all* types of fuel firing equipment? Do you know, for instance, that great improvements have recently been made in Taylor Stokers?

These are *basic* improvements in the tested Taylor Stoker principles of operation that have proved their value many times over during 39 years in hundreds of installations. Stoker design is now vastly simplified for more precise control of coal feed, combustion and ash discharge. Emphasis is placed on features that mean more economical, automatic operation for low cost steam generation under the widest variety of conditions.

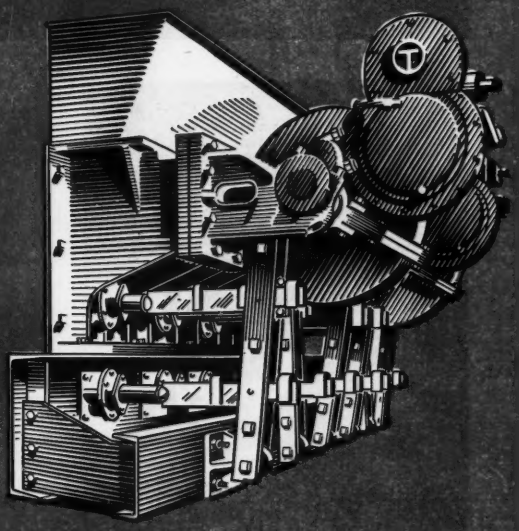
All the advantages of the Improved Type "R" Taylor Stoker are detailed in a new, highly informative booklet. Be sure to have the facts before you when you specify power plant equipment. Write for this booklet *today.*

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.

ANOTHER IMPROVEMENT IN THE TYPE "R" TAYLOR STOKER



MORE EFFICIENT FIRING WITH STRAIGHT LINE DRIVE

Complicated mechanisms are eliminated from the improved Taylor Stoker front end drive, which means easier, more efficient regulation of coal feed and fuel bed movement. Simplified straight line drive of coal rams and secondary pushers increases efficiency and "on line" time.

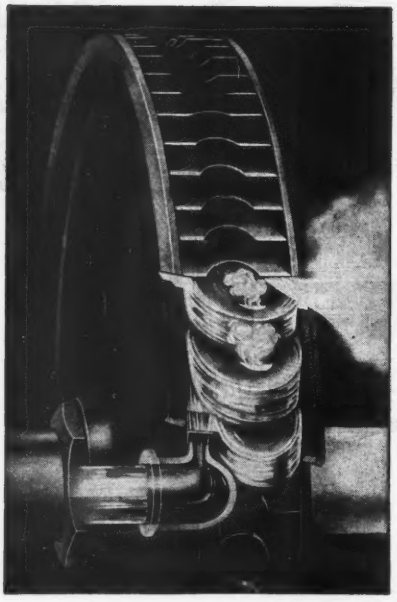
Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PA.

The TERRY



Action of steam in Terry Solid Wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket, in which its direction is reversed 180°. The steam is caught in a stationary reversing chamber and returned to the wheel. This process is repeated several times.

USES A SOLID STEEL ROTOR

The rotor of the Terry Wheel Turbine is made from a single forging of spec composition steel. The semi-circular buckets or pockets are milled from the sol metal. The steps in the machining of a wheel are shown below. There are no pa to become loose or work out.

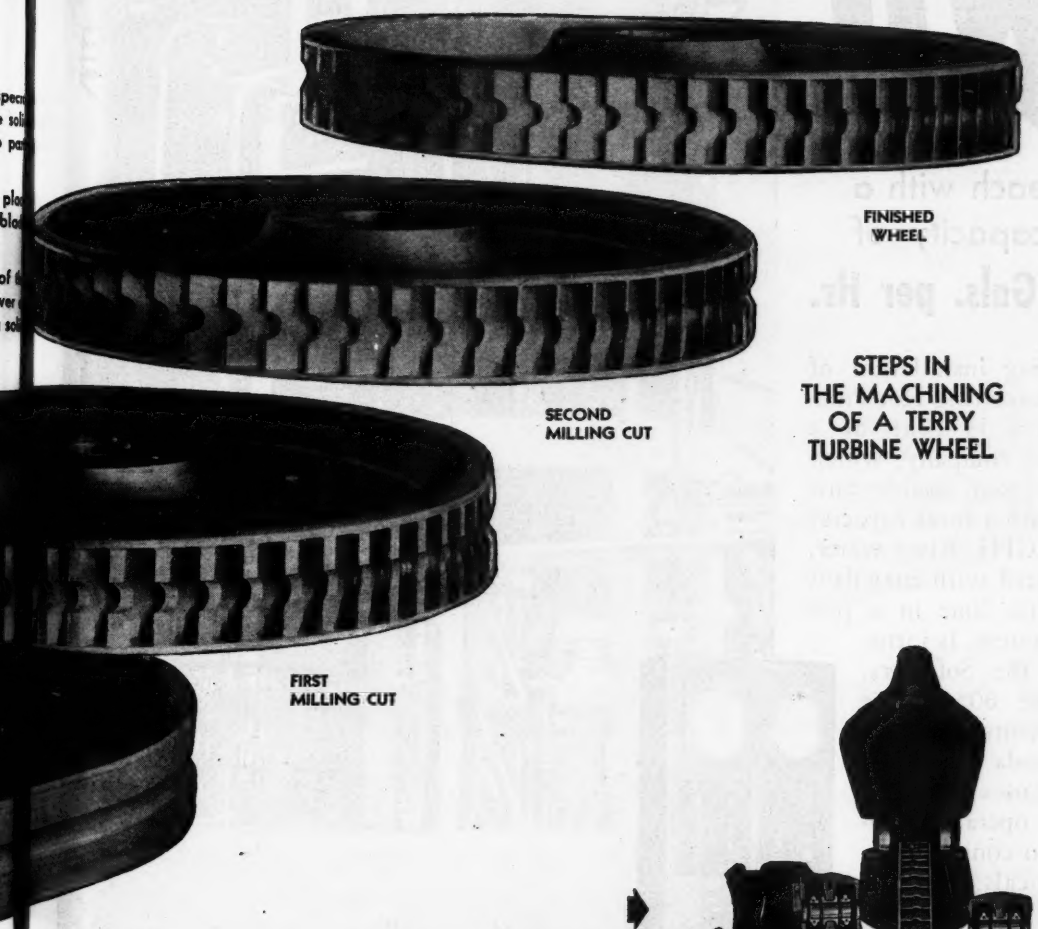
The power-producing action of the steam in the wheel buckets takes pla entirely on the curved surface at the back of the bucket and therefore close bla clearance is not necessary.

As the only function of these blades is to form a series of pockets, wear of t blades is of little consequence and does not materially affect the horse power efficiency. The important part of the bucket is the back or bottom, which is a so forging.

FORGING — ROUGH TURNED

THE TERRY STEAM TURBINE CO.

Wheel Turbine



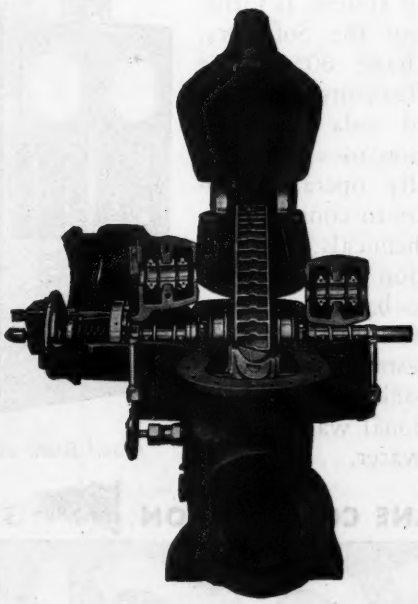
FINISHED WHEEL

SECOND MILLING CUT

FIRST MILLING CUT

SMOOTH TURNED

STEPS IN THE MACHINING OF A TERRY TURBINE WHEEL



Typical Terry Solid Wheel Turbine with cover and bearing caps raised. Note the ruggedness and the accessibility of all parts. Units of this type are used to drive boiler feed pumps, generators, and all types of power plant equipment. Built in sizes from 5 H.P. to 2000 H.P.

FOR FULL DETAILS ASK FOR BULLETIN S-116

T-1156

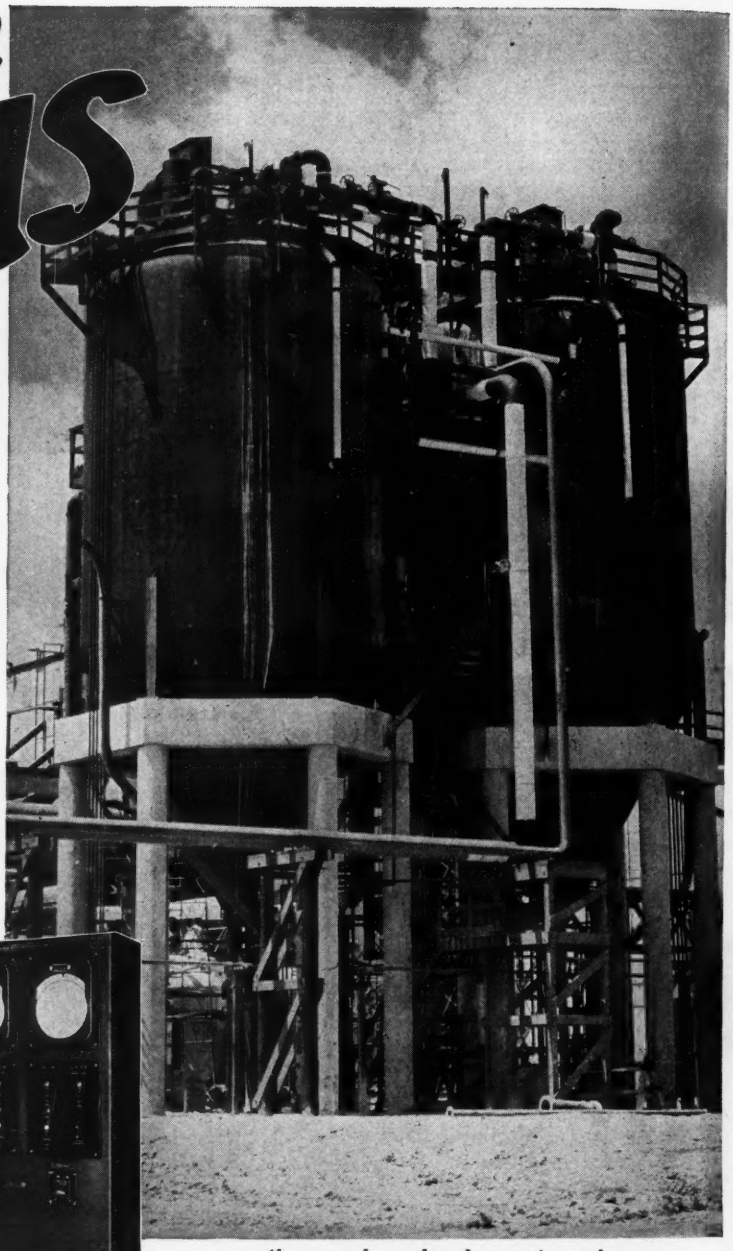
TERRY SQUARE - HARTFORD, CONN.

2 sets of TWINS

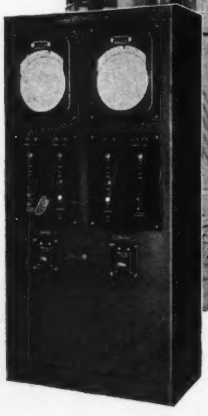
each with a capacity of

50,000 Gals. per Hr.

An interesting installation of Cochrane Deaerating Hot Process Softeners is that of a Southern oil company, which has erected two double-unit softeners, with a total capacity of 200,000 GPH. River water, already treated with coagulant and dolomitic lime in a preclarifying system, is introduced into the Softeners, which have 60° sludge cones. Reagents used are lime and soda ash. One installation uses Cochrane electrically operated proportioners to control individual chemicals; the other installation uses dry feeders. The battery of nine 10-ft. filters have individual valve nests so that they can be back-washed in the conventional way or with filtered water.



Above are shown the sedimentation tanks of one of the twin units. Note 60° sludge cones.



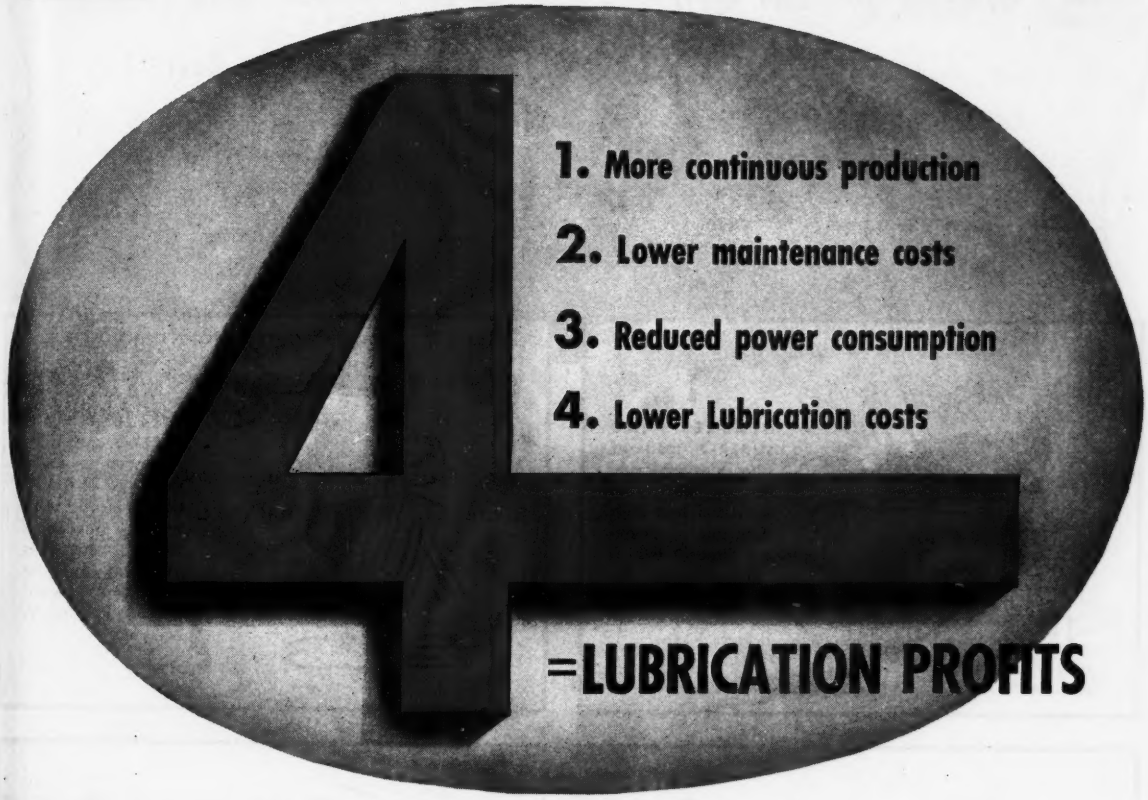
Panel Board with Flow Meter Control of Chemical Feed

COCHRANE CORPORATION 3123 N. 17th ST., PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

Your 4 Best Oil "Specifications"



Socony-Vacuum's 4-Factor Story

No matter what machines you operate—you'll find that your best specifications for oil or grease are *ultimate results*.

You're not interested in the oil or grease as such. You're after continuous production, uninterrupted by machine failure. You want lower maintenance costs from maximum machine protection, reduced power consumption from lower frictional losses and, finally, you want lower lubrication costs.

In short, what you want are the 4 factors of Socony-Vacuum Correct Lubrication—the 4 factors that add up to lubrication profits for your plant.

You can get these 4 factors now with Socony-Vacuum's *complete lubrication program* for your plant. For this program not only means the best quality lubricants for specific needs, but also includes skilled engineering counsel for scientific application, latest storage and handling methods, charts, controls and even progress reports of benefits obtained.

See your Socony-Vacuum representative and *specify* the 4-factor story for your lubrication dollars.

GARGOYLE Lubricants

Call in **SOCONY-VACUUM** *for Correct Lubrication*

SOCONY-VACUUM OIL COMPANY, INC., Standard Oil of N. Y. Division • White Star Division • Lubrite Division • Chicago Division White Eagle Division • Wadhams Division • Magnolia Petroleum Company • General Petroleum Corporation of California

Every Belt a Specialist

In Allis-Chalmers' Great New V-Belt Line!

When Allis-Chalmers recommends a certain belt for a certain job, you can be sure it's the *right* belt. Because: 1) the Texrope line is *complete;* 2) Allis-Chalmers invented the multiple V-belt drive, offers engineering advice based on unparalleled experience. Both sound reasons for making Allis-Chalmers your "V-Belt Drive Headquarters."

1

HEAT-RESISTING SUPER-7, made of Buna-S synthetic rubber, has ability to withstand heat built right into it. Standard Super-7 belt, it can successfully operate in ambient temperatures up to 180 degrees F.

2

OIL-RESISTING SUPER-7 specializes in operating under fairly bad oil conditions. Neoprene, a synthetic impervious to oil, grease, other grimy liquids, is the cover for the regular Buna-S Texrope V-belt core.

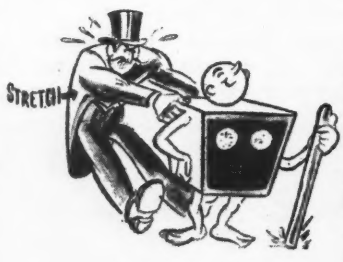
3

OIL-PROOF SUPER-7 is made of solid Neoprene, which is unaffected by most rubber-attacking liquids. It is recommended for drive installations where V-belts are virtually swimming in oil or grease.

4

STATIC-RESISTING SUPER-7 conducts static charge to machine to ground it. Static conducting element is contained throughout belt cover — can't wear off. This belt is used where explosion danger is present.

♪ *Tune in the Boston Symphony, Blue Network, every Sat. Eve.*



5

SUPER-7-STEEL employs endless cables of steel to reduce belt stretch, provide greater horsepower. It is used where V-belt drive centers are hard to adjust, loads to be driven are extra heavy, space is limited.

A 1731

It pays to make

ALLIS-CHALMERS

your

V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F Goodrich—and are sold exclusively by A-C.

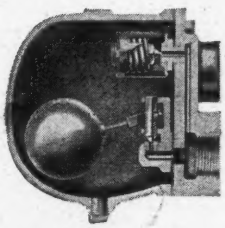
IT'S NEVER TOO HOT

OR TOO COLD

with Sarco!

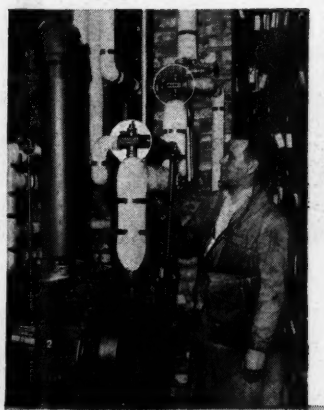
Uneven temperatures of steam equipment mean irregularities in production, slow-ups, second grades. Higher fuel, water and labor costs are the results.

Sarco holds temperature day in and day out. Sarco users "Set it and forget it" and say that it's "never too hot or too cold."

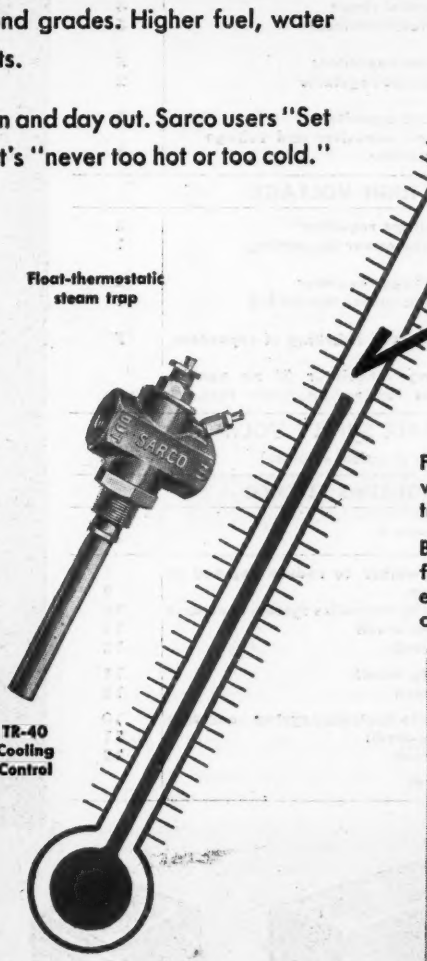


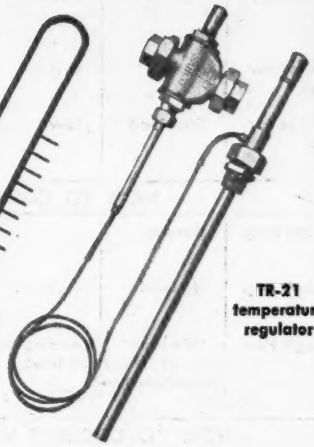
Float-thermostatic steam trap

Compressor cooling water temperature controlled by a Sarco TR-40. The results: Increased engine efficiency, less cooling water used, overflow used in wash tanks. The cost — negligible.



TR-40 Cooling Control

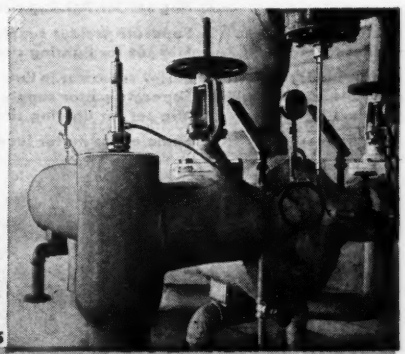




TR-21 temperature regulator

Frequently large volumes of heat otherwise wasted can be used if temperature controlled.

Below — spent cooling water at 110°, formerly wasted, is boosted to 120° by exhaust steam, and the temperatures now controlled by a Sarco TR-21.



.46

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

Represented in Principal Cities

SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

12 EASY METHODS OF IMPROVING VOLTAGE ON YOUR PLANT CIRCUITS

HOW TO CORRECT LOW VOLTAGE

Feeder Voltage Condition	Circuit Loading	Power Factor	Correct by means of	See Fig.
Low	Normal	Good	Transformer tap setting	1
			Voltage regulator	2
			Autotransformer	3
High feeder drop	Normal	Good	Voltage regulator	2
			Parallel circuit	4
			Autotransformer	3
High feeder drop	Normal	Low	Shunt capacitors	5
			Voltage regulator	2
High feeder drop	Overload	Low	Shunt capacitors	5
			Shunt capacitor and voltage regulator	6

HOW TO CORRECT HIGH VOLTAGE

Normal drop	Normal	.....	Voltage regulator	2
			Transformer tap setting	1
Normal drop	No load	.....	Voltage regulator	2
			Transformer tap setting	1
Voltage rise	"No load" (except shunt capacitors are on)	Leading at no load	Automatic switching of capacitors	7
			Voltage regulator (if no penalty clause for leading power factor)	6

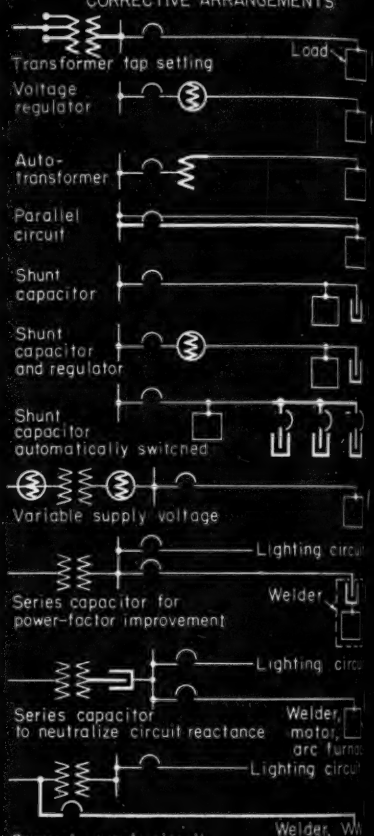
HOW TO CORRECT VARIABLE SUPPLY VOLTAGE

(Voltage regulator is only practical solution) 8

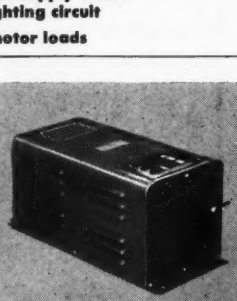
HOW TO CORRECT LIGHTING FLICKER

Load Causing Flicker	Correct by means of	See Fig.
Resistance welders, spot or seam	Series capacitor with welder to reduce demand by power-factor correction	9
	Series capacitor in line to neutralize system reactance	10
	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Flash and resistance welders	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Motor loads, such as: sawmills, rubber mills, grinders	Series capacitor in line to neutralize system reactance	10
	Separate motor supply circuit	11
	M-g set for lighting circuit	12
Arc furnaces	Same as for motor loads	

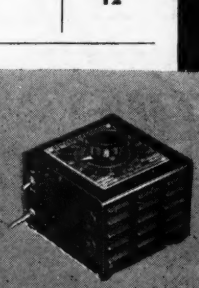
SCHEMATIC DIAGRAMS OF CORRECTIVE ARRANGEMENTS



THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB BETTER



Voltage stabilizers—Automatically provide a constant 115-volt supply to a given load on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes. Ask for Leaflet GEA-3634.

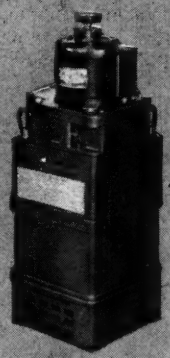


Variable-voltage autotransformer—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factory and laboratory. Described in Leaflet GEA-3635.

Motor-generator sets—Change a-c to d-c. Provide an inexpensive way to supply your lighting circuits independent of your power circuits to avoid lighting flicker. See diagrams 11 and 12. Described in Leaflet GEA-1945 (synchronous type); Leaflet GEA-394 (induction type).

FOR SUCH CIRCUITS WE RECOMMEND THESE AIDS TO BETTER VOLTAGE

Pyranol or oil-filled regulators—Ideal for regulating variable line voltage (see diagram 8), or voltage on plant feeders. Provide 10% regulation raise and lower; automatic operation; 12 to 120 kva, 2400 to 6900 volts. Described in Leaflets GEA-2443 (Pyranol), GEA-2018 (oil, 24 kva and smaller), GEA-2985 (oil, 34.5 kva and larger).



Dry-type regulators—Automatic types: Provide 10% regulation raise and lower on circuits such as diagram 2. Remote-motor or hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts. Described in Leaflet GEA-3057.

Dry-type transformers and autotransformers—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage, and phase changing. See diagram 3. Ratings up to 100 kva, 600 volts. Ask for Leaflet GEA-297.

Pyranol capacitors (series or shunt type)—For reducing kva demand, improving power factor, increasing circuit loadability on such circuits as shown in diagrams 5, 6, 9, 10. Described in Leaflet GEA-2742 for circuits 575 volts and below; Leaflet GEA-2860 for circuits 2400 to 13,800 volts.

"Auto-switch" capacitors—For application on high-voltage side of step-down transformers. Units are automatically connected or disconnected with rise or fall of voltage or current. Ideal for improving power factor at heavy load without causing overvoltage at light loads, thus reducing burnouts and replacement of lamps, coils, etc. Detailed information on request.

They will help you gain some or all of these benefits

- ★ Improved lighting (higher levels and the reduction or elimination of flicker); better starting of fluorescent lighting; longer lamp life
- ★ Increased motor efficiency; greater starting and running torque and speed; the reduction of motor heating and, hence, maintenance and machine outages
- ★ Reduced breakage and spoilage in textile and other mills where motor speeds must be constant
- ★ Better performance and greater reliability of electric equipment; the elimination of sluggish operation of potential or control devices
- ★ Greater production from electric furnaces, infrared heaters, drying lamps, and a wide variety of other electric equipment
- ★ Quality control and greater uniformity, fewer rejects, more accurate test results
- ★ Temperature control on heating circuits
- ★ Longer life of electric equipment; a reduction of overheating and burnouts; the protection of precision tools, electronic tubes, and delicate instruments
- ★ Kva demand reduced, power factor improved, increased circuit loadability and, often, reduced power cost

GOOD voltage is no longer a luxury. It is now easy and inexpensive to extend the benefits of good voltage to every nook and corner of your plant—benefits that quickly pay for the small initial cost of equipment.

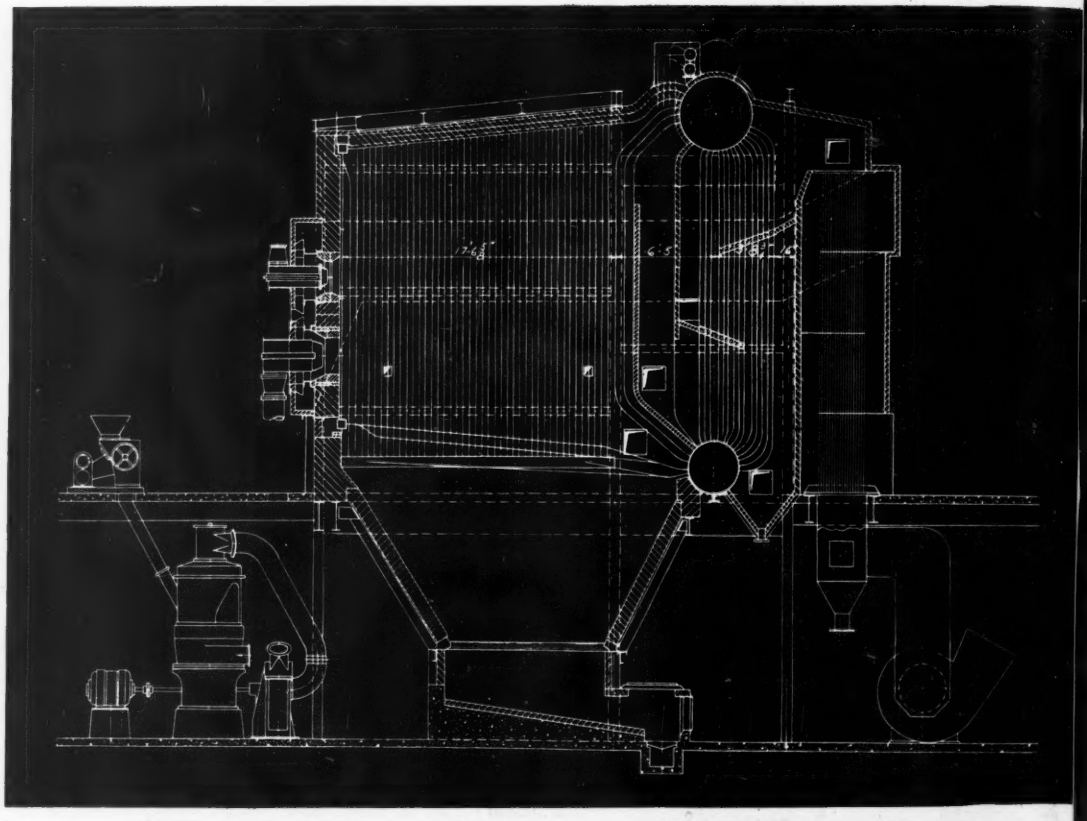
By good voltage we mean voltage that is neither too high, nor too low, nor extremely variable. A 10 per-cent *overvoltage* reduces incandescent-lamp life 75 per cent, decreases the power factor of general-purpose motors from 3 points at full load to 5 and 6 points at half load, and causes overheating in various potential devices. A 10 per-cent *undervoltage* decreases the light output of incandescent lamps approximately 30 per cent, increases the temperature rise of general-purpose motors 6 to 7 degrees C, reduces their torque and overload capacity approximately 19 per cent, cuts the output of a typical heating oven from 1500 to 1275 pounds per hour. Studies of the effect of poor voltage on other electric equipment show similar losses.

If you suspect poor voltage of being the cause of pepless motors, poor lighting, or production slumps at your plant, we'll be glad to help you make a system study. This will determine what corrective measures are necessary. Remember that whether you need voltage regulation for your plant as a whole, for your laboratory, for a vacuum tube, or a power shovel there is a simple, economical G-E device for the job. *General Electric, Schenectady 5, N. Y.*

GENERAL ELECTRIC

408-78-5206

AN INSIDE STORY



This VU unit, subject of the report on the opposite page, was designed to produce, at maximum continuous rating, 75,000 lb of steam per hr at 250 psi and 545 F total temperature. The unit is fired by both pulverized coal and blast furnace gas, employing these fuels separately or in combination, as desired.

VU Units meet a wide range of requirements

VU Steam Generators are in service for capacities ranging from 20,000 lb to 300,000 lb of steam per hour; design pressures up to 1,000 psi; total temperatures as high as 915 F. Designed for firing with pulverized coal, oil, gas or combinations of these fuels; also adaptable to all types of stokers.

C-E

COMBUSTION

Y OF VU PERFORMANCE

FIELD REPORT ON ANOTHER C-E INSTALLATION

The evidence left inside a boiler after long, continuous operation tells a significant story. Here is the inside record of a C-E Steam Generator, Type VU, shown on the opposite page, in one of the plants of a large Pittsburgh chemical company. *Eleven months* after its installation this unit was shut down for the *first* time, and then only for State and insurance inspection. The inspection showed:

1. A constant water line across full width of drum; variation of only 1 to 2" from normal water level.
2. A light, easily-washed-off phosphate coating on drum, steam washer and boiler tubes.
3. Slight deposits in water wall tubes and headers. No turbining required.
4. Light ash deposits on furnace walls. Tubes, fins and exposed refractory in excellent condition.
5. Soot blowers and baffles in fine condition. All boiler passes clean.
6. Normal, moderate wear of Bowl Mill. Exhauster blades and liners replaced although still good for additional service.

That is the inside story of a VU Steam Generator. During 11 months of continuous service, operating with 100% feedwater makeup, it produced 402,244,000 lbs of steam at an average rate of 50,000 lb per hr every hour of the entire period. It tells why these C-E Units can be depended upon for a notably high use factor and low maintenance. No user can get more out of a boiler than its manufacturer puts into it, and the foregoing evidence that these desirable qualities are virtually built into VU Boilers is further substantiated by the long and excellent performance records of hundreds of VU installations in all types of industry throughout the country. A-862

ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

It couldn't possibly happen

BUT THERE WAS GRAVY IN THE BOILER WATER

You might call it the Great Foam Mystery, for in spite of the most careful treatment, boilers in a certain great industrial plant would suddenly start to foam.

To Hall engineers that meant that the water must somehow have become contaminated. Tests of the boiler water showed reactions that could not have been normally produced.

A check of all piping was made by the Hall engineer. At first this check was without result, but finally a check on a day when trouble occurred showed contamination in a condensate section which had at first been given a clean bill of health. From that point, the trail led to one of the plant cafeterias.

The sketch shows what was happening—how a situation that couldn't possibly exist was causing trouble in the boiler room—a valve turned off —a vacuum in the steam jacket—gravy in the warming kettle sucked up into the jacket and returned to the boilers—then foaming. There *had* been a series of inexplicable losses of gravy, sauces, soup and pudding in the past and the dates of these losses coincided with the dates of trouble in the boiler room.

Of course, contamination from such a source is rare, but the point of the story is that Hall service and Hall responsibility go far beyond prescribing chemicals to be added to the boiler water.

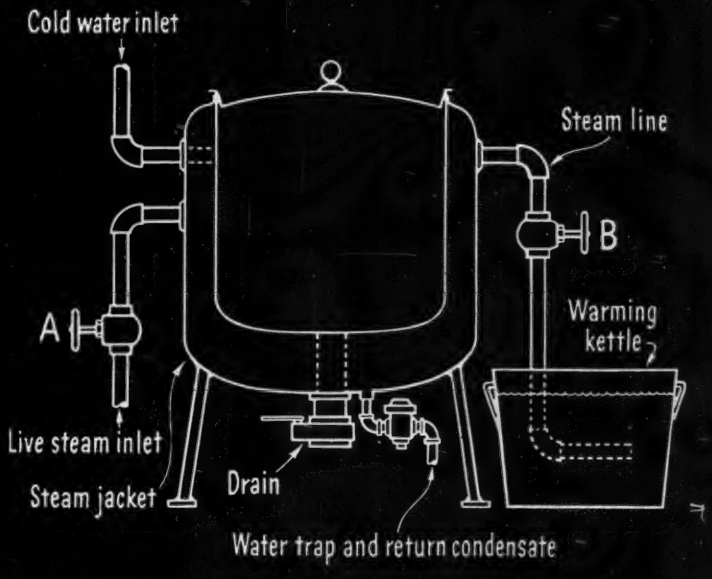
Hall service engineers check *all factors involved in boiler performance* and, in the event of trouble, trace that trouble down to its source.

Every plant that generates its own steam power can profitably use Hall service. Write us for full information.

HAGAN
HALL
BUROMIN
CALGON

HALL SYSTEM of B

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.



HERE'S WHAT HALL CLIENTS GET:

1.

2.

3.

4.

5.

6.

f Boiler Water Conditioning

SUN GLASSES

SKIING GLASSES

SWIMMING GOGGLES

WELDING GOGGLES

IN METALS TOO
It all depends on what you want to do

SELECTION GUIDE TO INCO NICKEL ALLOYS

PROPERTY:	MONEL	"K" MONEL	"S" MONEL	"R" MONEL	"KR" MONEL	INCONEL	"Z" NICKEL	NICKEL
CORROSION RESISTANCE	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
STRENGTH	GOOD	GOOD	HIGH	HIGH	GOOD	GOOD	HIGH	GOOD
TOUGHNESS	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH	HIGH	HIGH
HARDNESS	GOOD	GOOD	GOOD	GOOD	HIGH	FAIR	HIGH	GOOD
MACHINABILITY	GOOD	HIGH	GOOD	HIGH	GOOD	GOOD	GOOD	GOOD
NON-GALLING	NO	NO	NO	NO	HIGH	NO	NO	NO
SPRING PROPERTIES	GOOD	NO	HIGH	NO	NO	GOOD	HIGH	HIGH
ELEC. CONDUCTIVITY	POOR	POOR	POOR	POOR	POOR	GOOD	GOOD	POOR
HEAT RESISTANCE	GOOD	GOOD	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH
HEAT TREATABLE	NO	NO	YES	YES	YES	NO	YES	NO
NON MAGNETIC	NO	NO	YES	YES	YES	NO	NO	YES

When it's a question of finding a metal for some tough job you have in mind there is a quick way to look for a ready answer...

Take a look at the family of Inco Nickel Alloys—strong, hard, corrosion-resisting and absolutely free from rusting, every one of them. Those are the family characteristics of the eight Inco Nickel Alloys.

Which one should you choose for your particular job?

It all depends on what you want to do.

From this "Selection Guide" you can see how each one provides a different combination of advantages for different types of work.

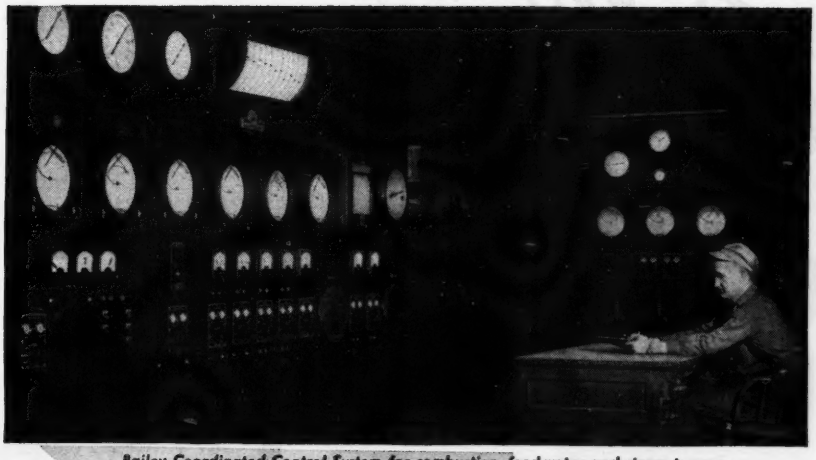
Then write for a copy of our List "B-100" which lists more than 100 technical bulletins and publications that explain the properties, corrosion-resisting characteristics and practical applications of these INCO Nickel Alloys. It is yours for the asking.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Photo credits (left to right): Ewing Galloway, N. Y.—American Spectacle Co., N. Y. American Spectacle Co., N. Y.—Black Star, N. Y.

NICKEL (INCO) ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • Sheet . . Strip . . Rod . . Tubing . . Wire . . Castings . . Welding Rods (Gas & Electric)



Bailey Coordinated Control System for combustion, feed water and steam temperature at the Wyandotte, Michigan Plant of Wyandotte Chemicals Corporation.

COORDINATED BOILER CONTROL

INSURES

1. **Fuel conservation without sacrifice of load.**
2. **Power services at competitive costs.**
3. **Increased safety to both plant and personnel.**
4. **Improved continuity of service.**

★ Bailey Boiler Control coordinates combustion, feed water, steam temperature, heater levels, pump speeds, and other related factors which must all be in balance to insure optimum boiler performance. Control impulses originate in the metering equipment and are coordinated by the control system so that all points of control are regulated in harmony with each other and with load demand.

Each Bailey Boiler Control System effectively reduces fuel consumption per pound of steam generated, increases safety of operation, and improves continuity of service, because it is carefully engineered to the requirements of the unit which it serves. Bailey engineering service starts with the selection of suitable metering and control equipment and continues through the design, construction, calibration, installation, and final adjustment on the job. Much of this engineering work is done in the user's plant by Bailey Field Engineers who are stationed in over thirty industrial areas throughout the United States and Canada.

The Bailey Engineer in your community has a vast store of experience at his command, which includes tests on thousands of boiler installations covering a wide range of fuels, furnaces, and fuel burning equipment. He is in a position to help you secure maximum fuel conservation together with the other benefits which result from intelligent use of correctly selected and properly coordinated boiler control. G-25

BAILEY METER COMPANY
1040 IVANHOE RD. • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

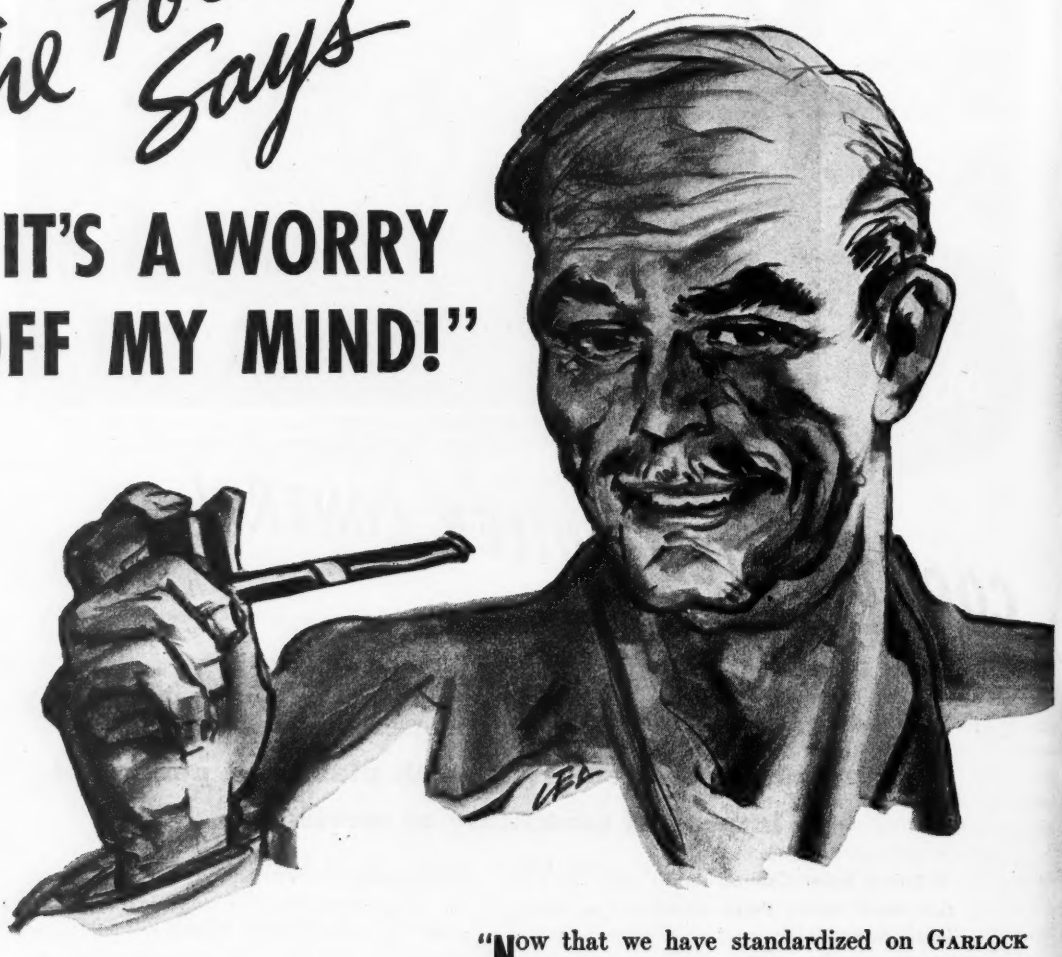
BAILEY METER CONTROL

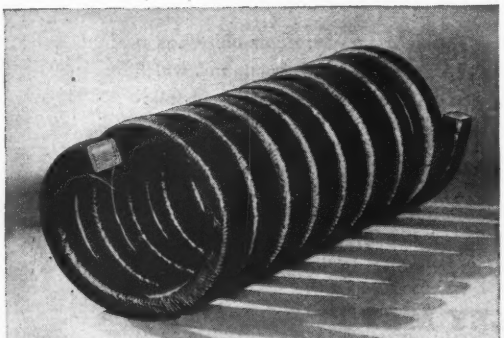
BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

The Complete Combustion Control System

The Foreman Says

"IT'S A WORRY OFF MY MIND!"





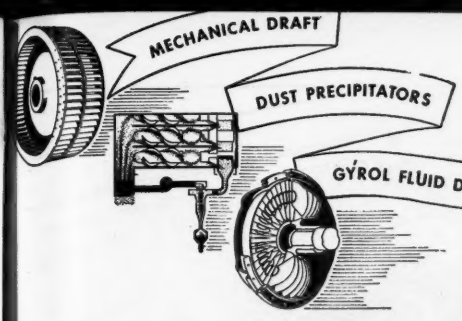
GARLOCK 150 High Pressure Steam Packing is one of the large number of GARLOCK *quality-controlled* products. Illustration shows spiral form (GARLOCK 150). Coil form—GARLOCK 125. Ring form—GARLOCK 200.

"Now that we have standardized on GARLOCK Packings, Gaskets and KLOZURE Oil Seals, I can sleep nights! No more worries about interrupting essential production on account of frequent shut-downs for repacking, etc."

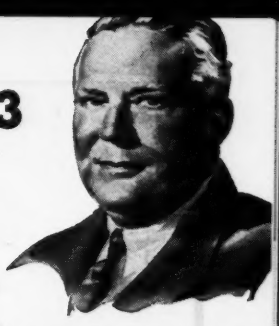
GARLOCK products give long, dependable service because they are manufactured in our own plant and are *quality-controlled* from raw material to finished product.

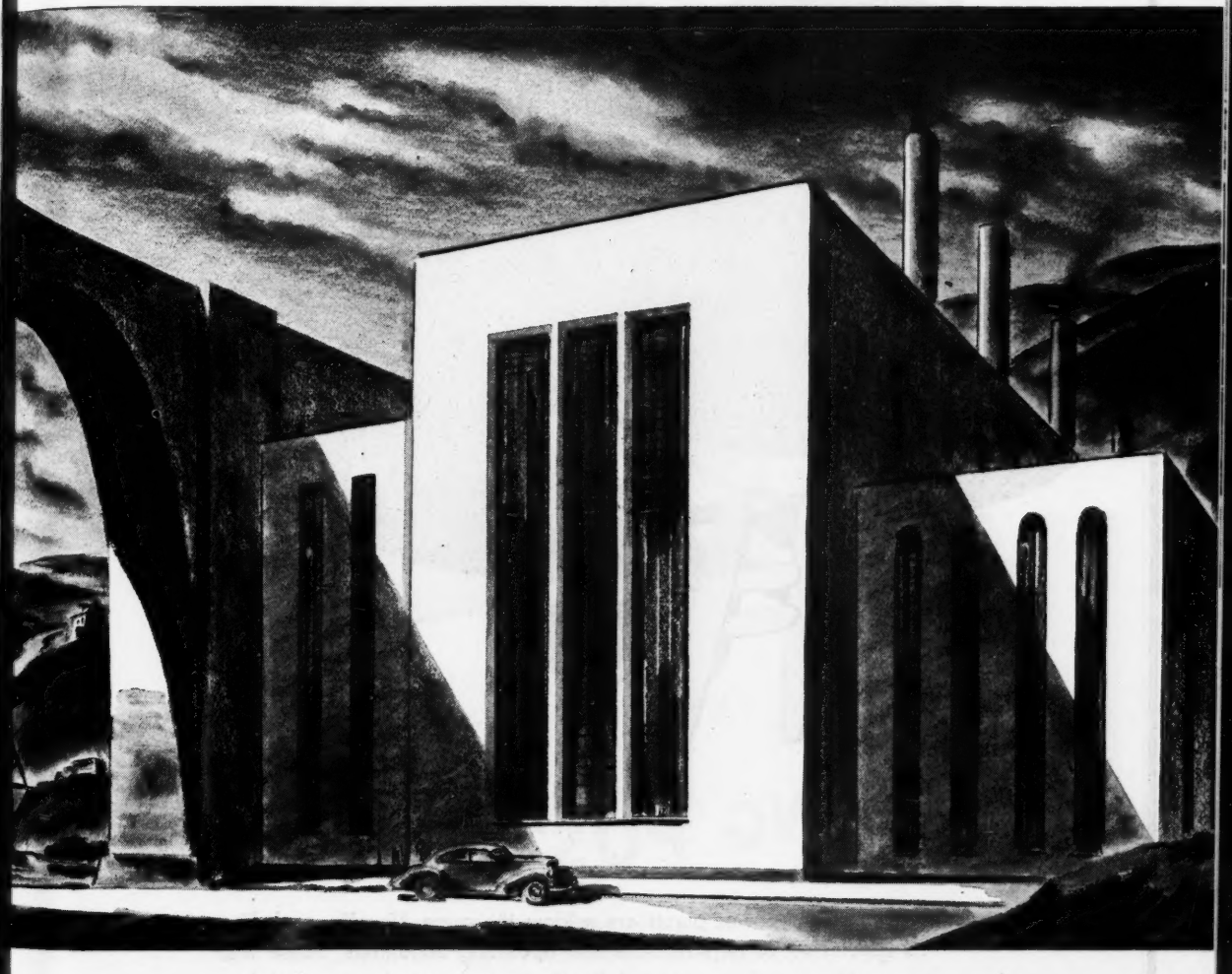
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Garlock



You can buy all 3 from me





Call in an American Blower representative. Let him show you why it is to your advantage to buy American Blower Mechanical Draft Fans, Gyrol Fluid Drives and ST Dust Precipitators as a group from *one* source of supply . . . One purchase order, one source of technical information, less red tape, better service and greater all-around satisfaction, are a few of the many benefits to you of buying all 3 from A.B.C.

HOW TO SOLVE YOUR FLY ASH PROBLEMS. 1) Carefully select a sample of the material you wish collected (our engineers will send you complete instructions for gathering and packing sample or they will gather a sample for you). 2) Ship your sample to the American Blower Dust Testing Laboratory (shown on right). We'll run tests, determine the equipment best suited to do your individual job, and give you complete data on installing American Blower time-proved Dust Precipitators. In the last 20 years, we have run tests on more than 4100 distinctly different materials. Our experienced engineering staff and the finest facilities in the industry for testing, designing and building Dust Precipitators assure your satisfaction.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

PLANNING POSTWAR POWER?

Two steam power plants are seldom the same. Usually, each has its special set of requirements and operating conditions. These will govern the equipment selected. But there *are* certain *basic* principles, common to all, governing the *type* of equipment. They've been evolved through experience—and tested in use.

Whether you're building a new plant or expanding an old one, these principles will serve as a valuable guide for your functional planning. Westinghouse, builder of the majority of products in a modern power plant, is well qualified and ready to place this information at your disposal.

Westinghouse

PART ONE

GETTING STARTED

Types of Turbines
Sizes of Turbines
Turbine Speeds

PART TWO

PERFORMANCE DATA

Basic Operating Conditions
Deviations in Operating Conditions
Approximate Over-All Dimensions
Recommended Condenser Sizes
Choice of Condenser Size
Condenser Data Charts
Condenser Dimensions
Condenser Friction
Circulating Pumps
Condensate Pumps
Other Auxiliaries

THEN YOU NEED THIS BOOK

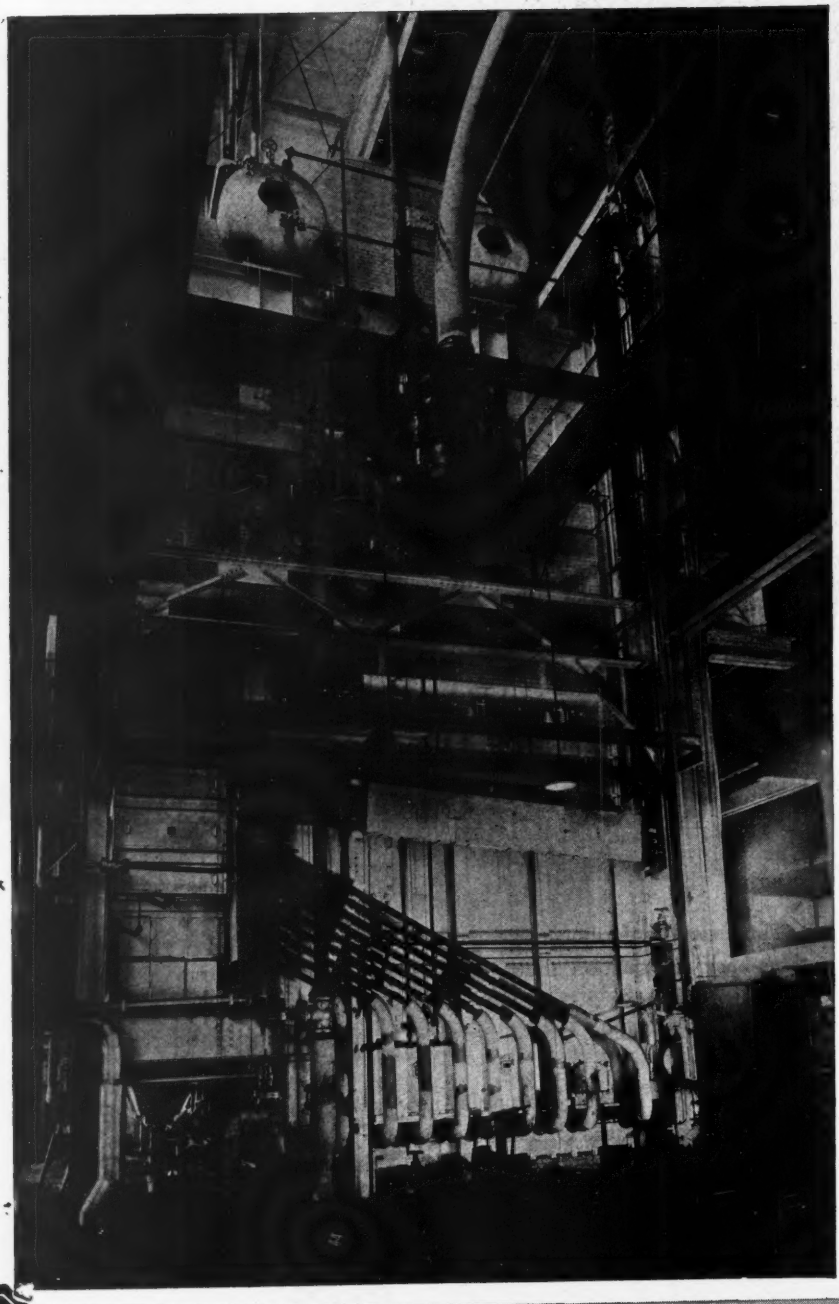
This new Westinghouse Steam Power Plant Planning Guide contains basic information about condensing-type turbines from 10,000 kw to 60,000 kw . . . and the condensers suitable for them. Using this Planning Guide, you'll be able to trace the functional plan of your plant.

For a copy of this valuable new planning book, call your nearest Westinghouse Office. No obligation, of course. Westinghouse Electric & Manufacturing Company, Box 868, Pittsburgh 30, Penna.

J-50457

Steam Headquarters

1940
1944
Duplicate



FW
FOSTER

Steam Generator

ORIGINAL UNIT EXCEEDED GUARANTEED EFFICIENCY AND MAINTAINED GUARANTEED CAPACITIES

Four years ago a large industrial plant installed a Foster Wheeler Bent Tube Steam Generator. Plant expansion recently necessitated additional steam capacity and a duplicate boiler was ordered. Determining factors which influenced this selection were the consistently low maintenance and high average yearly efficiency of the first unit. Efficiency for 1942 was 82.8%*, and for 1943, 82.6%* when burning midwest coals at a continuous load of 175,000 lb. of steam per hour, at 225 psi, 515 deg. F. final steam temperature and 215 deg. F. feed water to unit.

These Steam Generators are of the three drum, bent tube design and include completely water-cooled furnaces, superheaters, economizers and are fired with spreader type stokers.

*Design efficiency 83%. Corresponding test efficiencies approximate 84.5%.

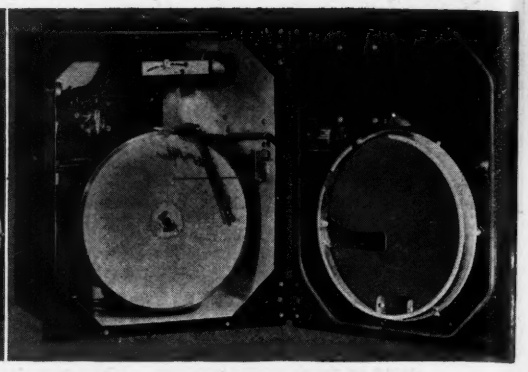
FOSTER WHEELER CORPORATION

165 BROADWAY • NEW YORK 6 • NEW YORK

WHEELER FW

Meter assembled as one unit on rack ready for calibration.

Meter assembly can be easily removed from the case.



Meter with door open showing accessibility of all adjustments and working parts.

Republic Boiler Meter

ON ONE CHART ○
STEAM FLOW
AIR FLOW
TEMPERATURE
OR PRESSURE

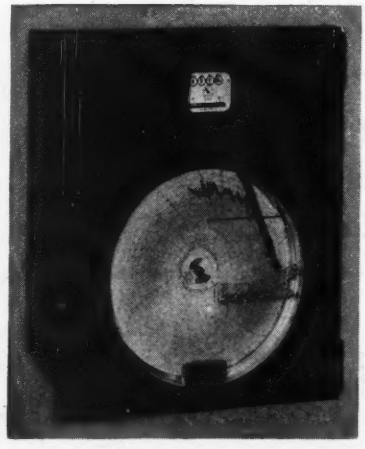
★ The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing.

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.

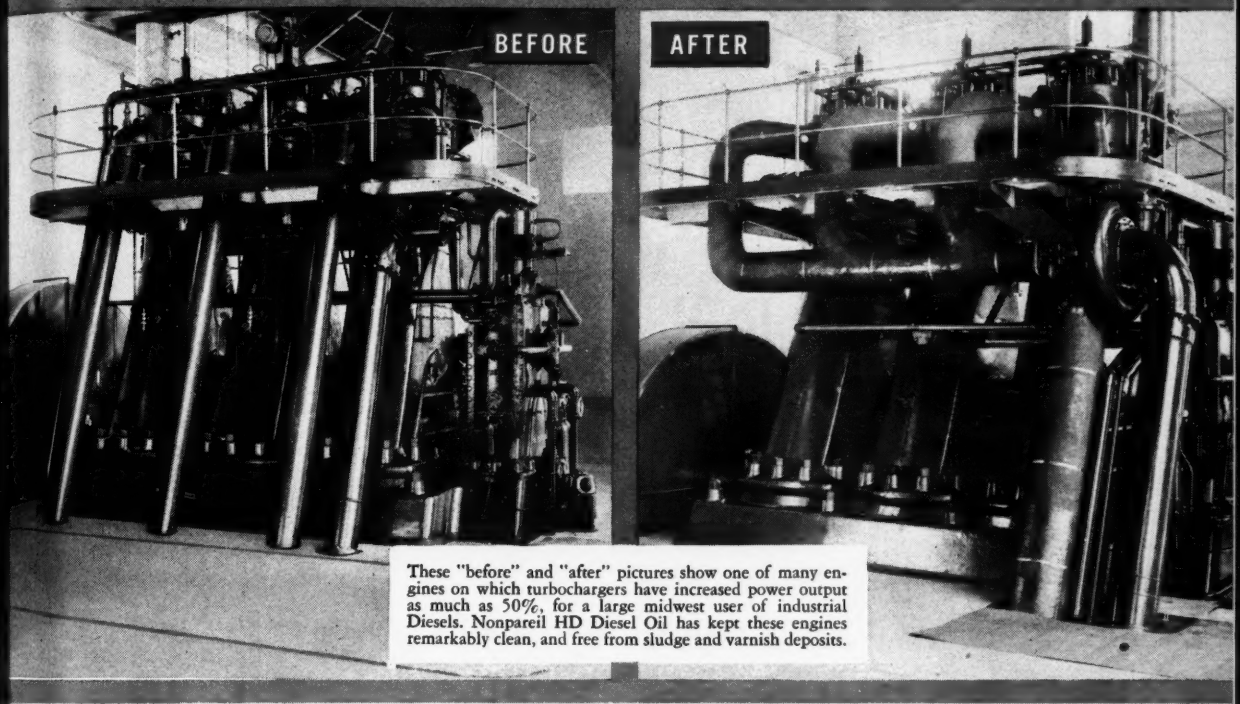


The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*

REPUBLIC FLOW METERS CO.

2224 DIVERSEY PKWY. CHICAGO 47, ILLINOIS

Increased Diesel output with turbochargers..



These "before" and "after" pictures show one of many engines on which turbochargers have increased power output as much as 50%, for a large midwest user of industrial Diesels. Nonpareil HD Diesel Oil has kept these engines remarkably clean, and free from sludge and varnish deposits.

...cut lubricating troubles with

NONPAREIL HD DIESEL OIL

CAUGHT BETWEEN the increased demands for power and the scarcity of new Diesel equipment, a midwestern industry turned to turbochargers. The results were highly pleasing. Some engines were increased from 500 horsepower to over 900 horsepower by increasing speed, converting to solid injection, and adding turbochargers. As much as 50% increase in output was obtained by supercharging alone.

Even before these engines were supercharged, however, higher loads and longer hours of operation had increased lubricating troubles. With the change-over, Nonpareil HD (a heavy-duty, detergent oil) was tried. Today the master mechanic reports not only a much higher output from the 12 supercharged engines, but he states: "Nonpareil HD has resulted in better lubrication than we have ever obtained." A further report states: "Nonpareil HD has resulted in unprecedented freedom from stuck rings... and crankcase cleanliness that has previously been impossible."

Nonpareil HD has proved, on these and other hard-to-lubricate Diesels, that it will help eliminate the most stubborn and troublesome deposits in Diesel engines.

Nonpareil Diesel Oil is made in HD (heavy-duty, detergent) and regular types. You can get an unbiased recommendation from a Standard Oil Lubrication Engineer as to which you need for your type of service. Write Standard Oil Company (Indiana) office, 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

Buy more War Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

The ~~"art"~~ *Science* of greasemaking— and you, the "user"

NOT MANY YEARS AGO, the "art" of greasemaking was handed down from father to son, or from the master greasemaker to his favorite apprentice. The greasemaker was a super-chef—his recipes a secret. Without

The "art" of greasemaking was handed down from father to son.

the magic word known only to the old-timer, the same ingredients and seemingly the same methods he used, produced anything but the expected results in the hands of the uninitiated apprentice.

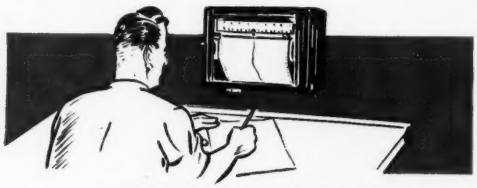
Today, that picture is greatly changed. Greasemaking

The master greasemaker was a super-chef — his recipes a secret.

is no longer an art but a science. The "know-how" of the old-timer is duplicated and improved upon in the chemist's laboratory.

Control of the various steps in the process, once dependent upon the experienced "eye" of the greasemaker, has been taken over by modern scientific instruments—accurate measuring and weighing devices, precision temperature control instruments, scientific mixing kettles, etc.

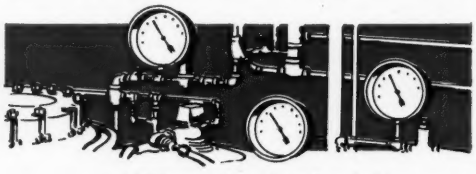
A high degree of skill is still required, but it is in the hands of thoroughly trained greasemakers, who, with accurate instruments and with laboratory formulas and methods, can predetermine the results of their



. . . accurate temperature measuring instruments.

labor and get uniform products that accurately meet specification requirements.

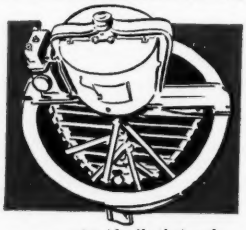
There was a time, too, when grease quality and consistency meant very little. The consistency of an axle grease on a wagon wheel had little effect on the speed of the wagon or life of the wheel. Today, however, high speed, precision anti-friction bearings, and heavily



. . . with laboratory formulas and methods.

loaded gears require accurate lubricant recommendations to save both power and wear.

All this explains why you will find the most advanced equipment and technique employed in the greasemaking department of Standard Oil. Only a small portion of the equipment is illustrated here. It can only indicate the extreme care and modern methods employed by Standard Oil to insure the highest quality and uniformity in the greases manufactured. And these include greases for practically every type of industrial application.



. . . scientifically designed grease kettles.

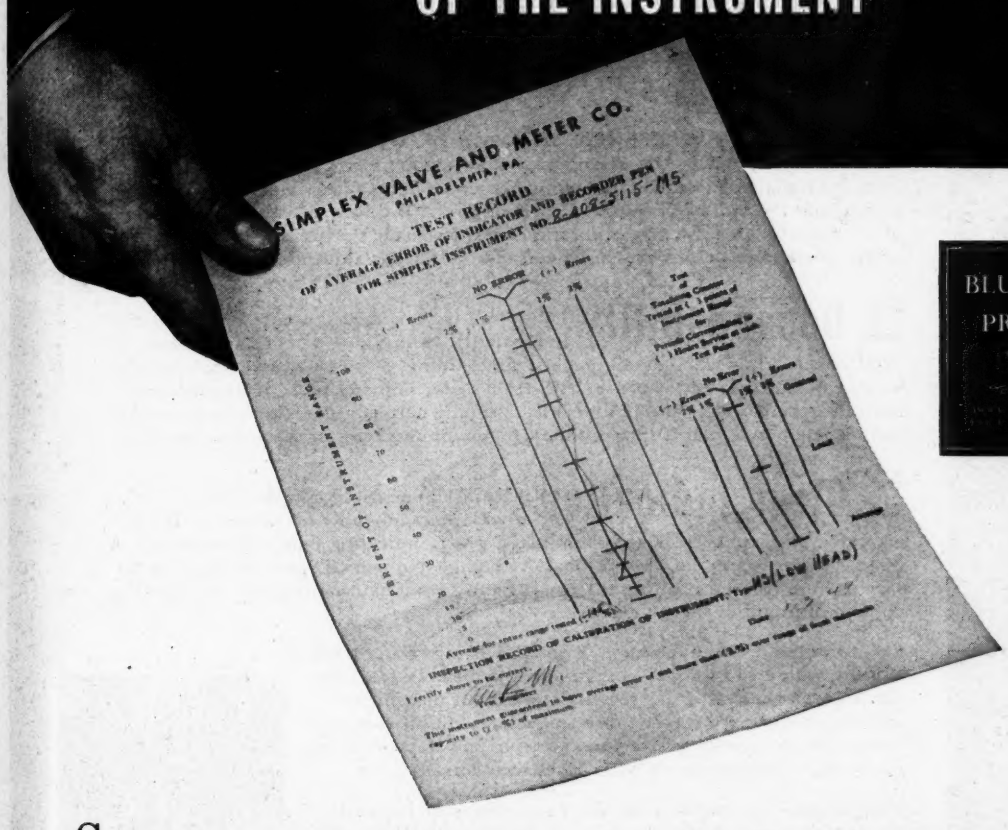
Standard Oil Lubrication Engineers will help you apply these products to give longer lasting protection to plant equipment and machines. Write Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Illinois, for a Lubrication Engineer.

Buy more War Bonds

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

Every SIMPLEX FLOW RATE METER IS TESTED OVER THE ENTIRE RANGE OF THE INSTRUMENT



Special hydrostatic testing equipment and production laboratory engineers plot a full accuracy curve of every Simplex Meter before it is shipped — and the curve showing the average error for each instrument is sent to the purchaser for his use.

Incremental differential heads are applied to the meter at predetermined percentages of capacity. By means of micrometer adjustment, the exact height of the water column is controlled within the narrowest limits.

This complete routine testing procedure is the final stage of production in the Simplex plant — your assurance that every Simplex Meter is not only accurate within the entire range of the guarantee, but is also specifically tested and inspected over its entire range before being shipped.

Write today for latest literature on Simplex Meters for use in accurately indicating, recording and totalizing rates of flow of liquids and gases encountered in the water, sewerage, process or power fields.

SIMPLEX VALVE & METER COMPANY

6783 UPLAND STREET, PHILADELPHIA 42, PA.

3 "MUSTS" for remote reading water level indication

★ ★ ★

EYE-HYE brings you all three

1 Accuracy EYE-HYE *accuracy* is in large measure due to its use of the scientific U-tube manometer principle. Actuation is from the Reliance patented Unitemp which compensates for temperature variation throughout the indication range. Provision for blowdown insures free movement of hydrostatic force. Factory calibration for the specific gravity of the water in *your* boiler guarantees perfect measurement without further adjustment.

2 Dependability EYE-HYE is *dependable* because of its positive hydrostatic operation — a constant means in itself of checking whether the gage is functioning. With no *mechanical* parts to wear, adjust or get out of order, EYE-HYE's one "moving part" is its one special indicating fluid. Over 5000 EYE-HYEs faithfully help engineers now in stationary and marine power plants to avoid the dangers of uncertain or inaccurate readings.

3 Clear Indication EYE-HYE reads like water gages you've always known—only it's close by, down at eye level. Sharp and clear, the illuminated green indicating fluid rises and falls in direct proportion to the conventional drum gage. No mental "gear shifting" necessary to interpret the reading, for you instantly *know* its meaning, like the familiar column of liquid in the gage above.

Easy to install, use and maintain, EYE-HYE brings water level reading where you want it—any reasonable distance from the drum—even *above* it if desired. Its convenient placement on wall or panel board forces more frequent attention to water level performance—protects you and your power plant from the danger and expense of water level accidents.

Plan ahead—investigate now the possibilities of increasing the efficiency and safety of your water level supervision, with EYE-HYE. Write for Bulletin 382-C.

Modern power plants install EYE-HYE on panel boards.

THAT READS JUST LIKE THE GAGE ON THE BOILER!

BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVE. • CLEVELAND 3, OHIO

1 Pill for 9 Headaches!

PAGES FROM "A GUIDE TO WARTIME CARE OF ELECTRIC MOTORS"

ALL NINE electric motor enemies are present and accounted for in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors." Streamlined instructions and story-telling pictures describe what they are, where they're found, how to fight them.

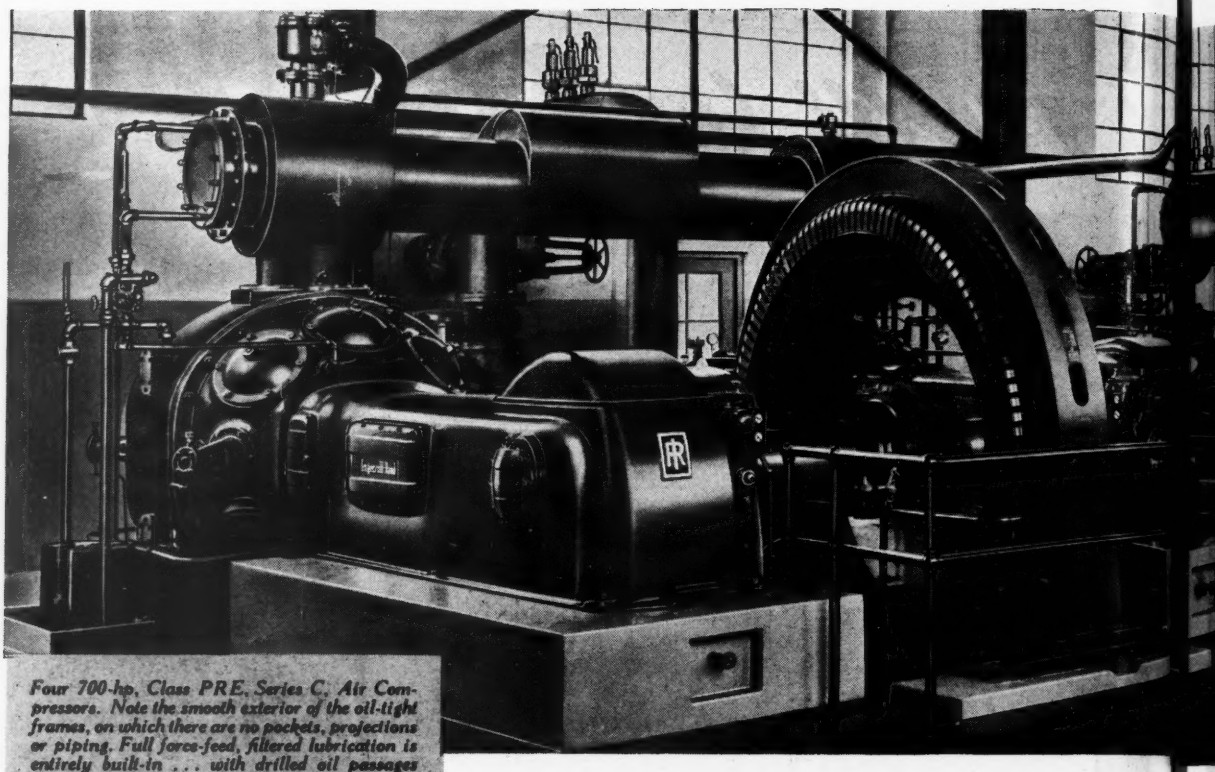
Designed for wartime U. S. industry, "Guide to Wartime Care of Electric Motors" has aroused such world-wide demand that Spanish and Portuguese editions are now printing!

You'll find this valuable new handbook ideal both for training new men and "brushing up" old hands. It contains no advertising. Write today for *your* free copy of this tremendously successful handbook to ALLIS-CHALMERS MFG. CO., MILWAUKEE, WISCONSIN. A 1625

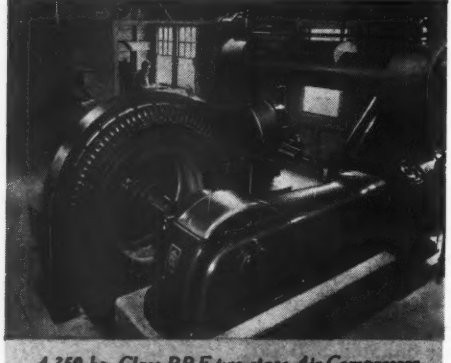
ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

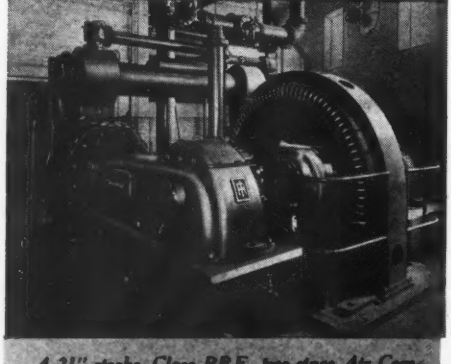
AC WE WORK FOR VICTORY WE PLAN FOR PEACE



Four 700-hp, Class PRE, Series C, Air Compressors. Note the smooth exterior of the oil-tight frames, on which there are no pockets, projections or piping. Full force-feed, filtered lubrication is entirely built-in . . . with drilled oil passages throughout. The crankcase, which need not be opened for adjustments, stays clean. Gauges on each frame indicate main-bearing oil pressure and temperature.



A 350-hp, Class PRE two-stage Air Compressor supplying air for operating rock drills in a mine.



A 21"-stroke, Class PRE, two-stage Air Compressor in a steel plant.

..We hope you were

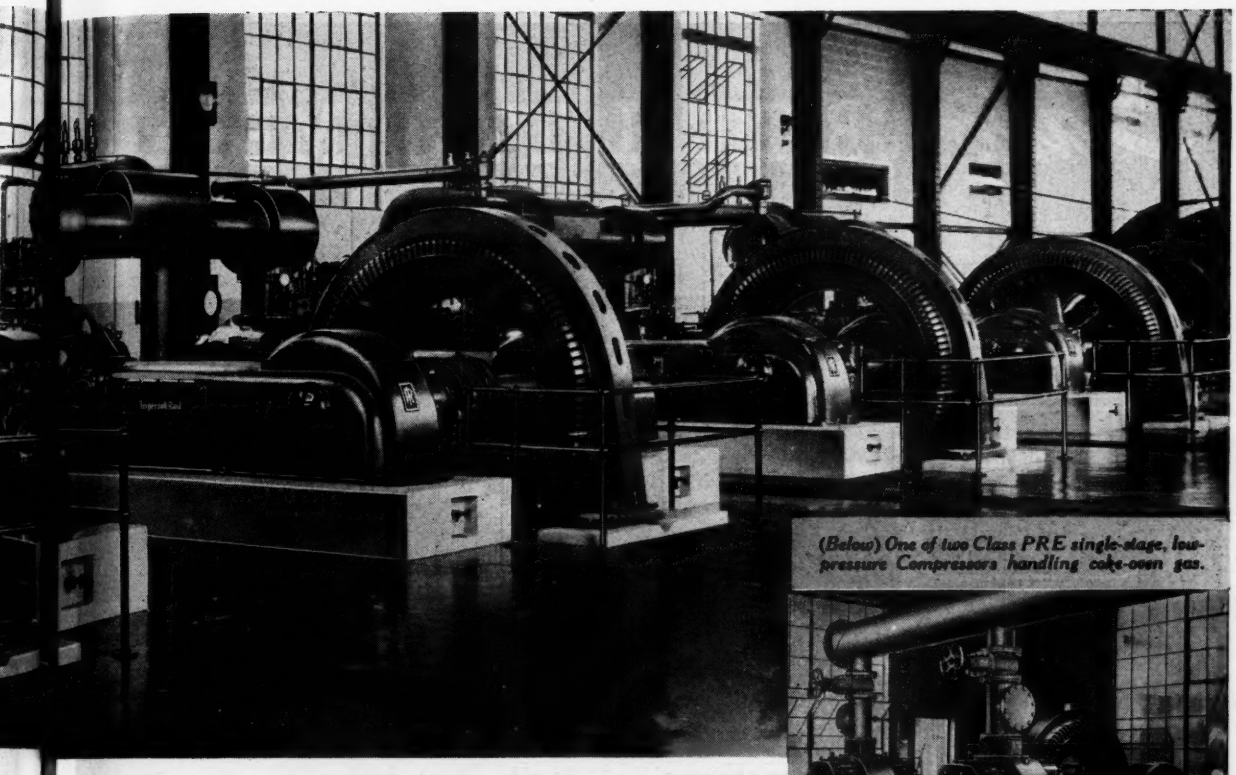
Compressors

Perhaps your company was one of those permitted by WPB to purchase a new Series C, Class PRE, during the hectic days when compressors were so critical to the war effort. If so, you now have a machine that's years ahead of conventional design. You will be proud of it for years to come . . . and you will save a lot of money in upkeep and power cost.

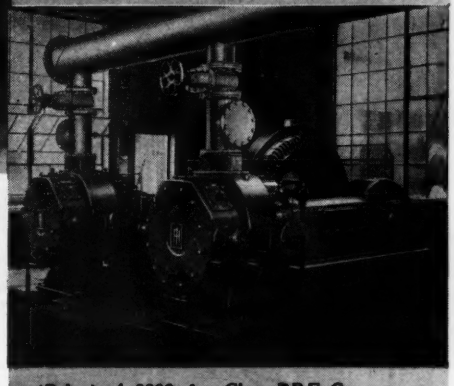
This compressor is new . . . yet hundreds of them are already in service, and have helped to make huge increases in the production of explosives, steel, rubber, ships, airplanes, and tanks—in fact, every kind of war materiel.

Its new frame and running gear represent a com-

COMPRESSORS • CONDENSERS • ROCK DRILLS • AIR TOOLS



(Below) One of two Class PRE single-stage, low-pressure Compressors handling coke-oven gas.



(Below) A 3800-cfm, Class PRE Compressor furnishing air at 100-lb pressure, and three 1-R Turbo-Blowers furnishing lower-pressure air for a copper mining company.

e lucky enough to get s like these!

plete change in construction, radically different from previous designs. Its features provide greater reliability and ease of maintenance . . . making it a machine that comes even closer to the "ideal" compressor that operators like to dream about.

If you are the owner of a new PRE, we need say no more... but if you are not, consult one of our Service Engineers who will gladly explain the many advantages of this heavy-duty electric-driven compressor.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 1-535

REMEMBER, all PRE Compressors are equipped with full, 5-step Clearance Control. This is the method of regulation that we originated, patented, and applied in 1910. It has been the standard for 34 years. We continue to use it because it is still the best method of regulating the output of large electric-driven compressors.

TURBO BLOWERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

Save CRITICAL TUBE METAL

Install JOHN CRANE
CONDENSER TUBE PROTECTORS

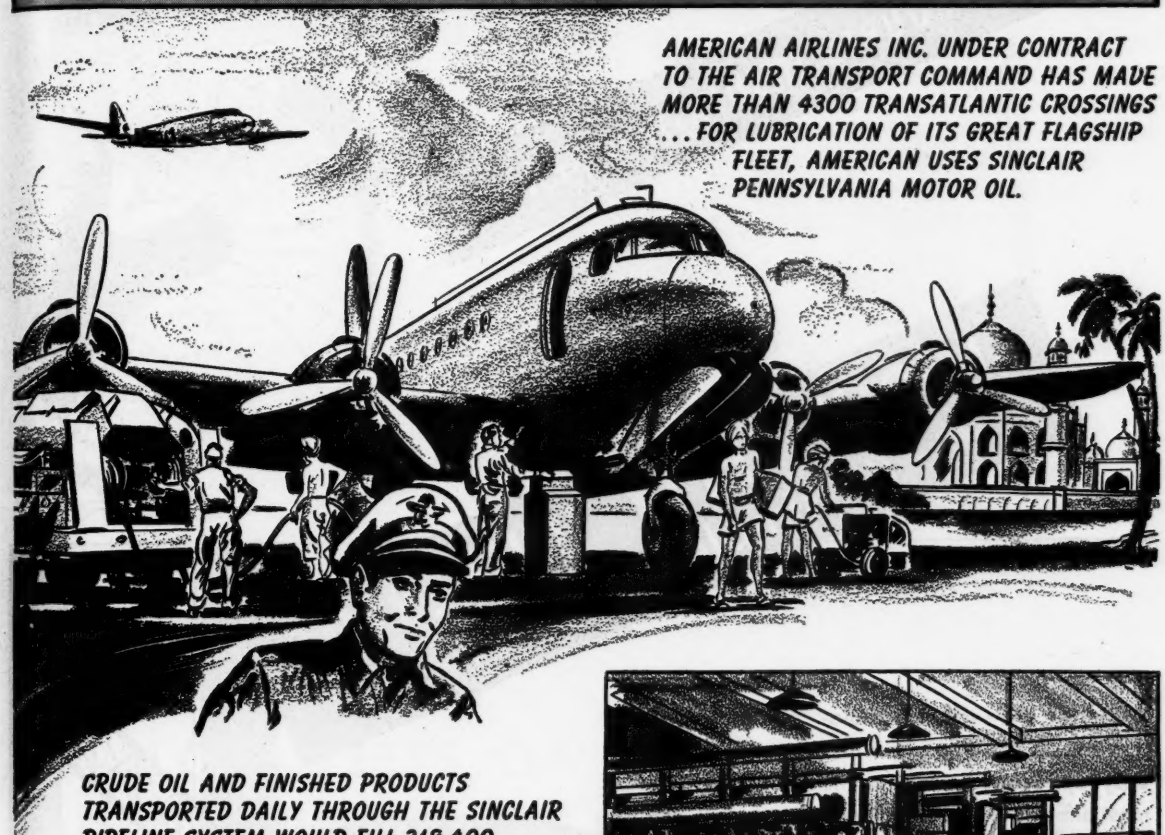
The inlet end of the condenser tube is most often the first section to fail. This is the area most vulnerable to air impingement and sand abrasion. Service Tests in Marine and Stationary Condensers prove that John Crane Condenser Tube Protectors *armor the entrance section; greatly lengthen tube life.* Note these other important advantages:

- **Molded of a hard, wear-resistant plastic material**
- **Resist contaminated salt or fresh water**
- **Unaffected by temperatures to 275° F.**
- **Provide a belled mouth for inlet tube ends; reduce turbulence**
- **Easily installed on both old and new tubes**
- **Last for life of tubes**

John Crane Condenser Tube Protectors are inexpensive to install; and require no special tools. Available for 5/8" and 3/4" 16-BWG, or 5/8", 3/4", 7/8" and 1" 18-BWG tubes. For full information send for *illustrated* bulletin, or consult our branch office *nearest you.*

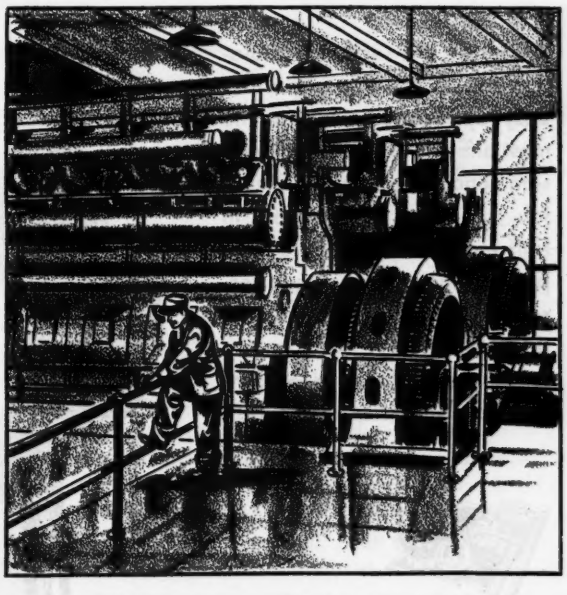
CRANE PACKING COMPANY
1812 CUYLER AVENUE • CHICAGO 13, ILLINOIS

Do you know that . . .



AMERICAN AIRLINES INC. UNDER CONTRACT TO THE AIR TRANSPORT COMMAND HAS MADE MORE THAN 4300 TRANSATLANTIC CROSSINGS . . . FOR LUBRICATION OF ITS GREAT FLAGSHIP FLEET, AMERICAN USES SINCLAIR PENNSYLVANIA MOTOR OIL.

CRUDE OIL AND FINISHED PRODUCTS TRANSPORTED DAILY THROUGH THE SINCLAIR PIPELINE SYSTEM WOULD FILL 318,400 55-GALLON DRUMS. THESE, STACKED END ON END WOULD BE 31 TIMES HIGHER THAN MT. EVEREST. SINCLAIR USES OLDEST CRUDES TO MAKE HIGHEST QUALITY LUBRICANTS.



SCUFFING AND RING STICKING ARE AVOIDED... PERFECT SEAL AND FULL DELIVERY OF POWER ARE ASSURED BY SINCLAIR RUBILENE AND GASCON OILS. THEY AND TEN-OL 200 ARE DESIGNED FOR BETTER DIESEL LUBRICATION.

SINCLAIR IS EQUIPPED TO SERVE YOU BETTER!

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

HAVING TROUBLE INSULATING BENDS?

SIMPLY APPLY UNIBESTOS
it's simple to apply!

Unibestos, the sectional insulation for all pipe sizes, permits easy application on even the most difficult-to-insulate expansion bends. Makes a clean, neat job. Unibestos is available in half-section form up to 30" pipe diameter and in quarter-sections from 32" to 60", in thicknesses from ¾" to 5". Available in single layer construction for service up to 1200°.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

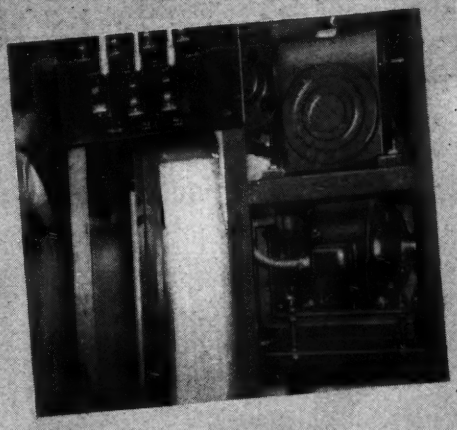
Copyright 1944

PLANTS: 1821 S. 54th AVE., CICERO, ILL.
PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • NEW YORK
SAN FRANCISCO • PATERSON, N. J.

IN STUFFY SPOTS

Many a motor must be located where walls, adjacent equipment, or materials cut down the free flow of air. Sometimes, as in the case of this wool-dryer drive, surroundings are hot, and stuffy, too.

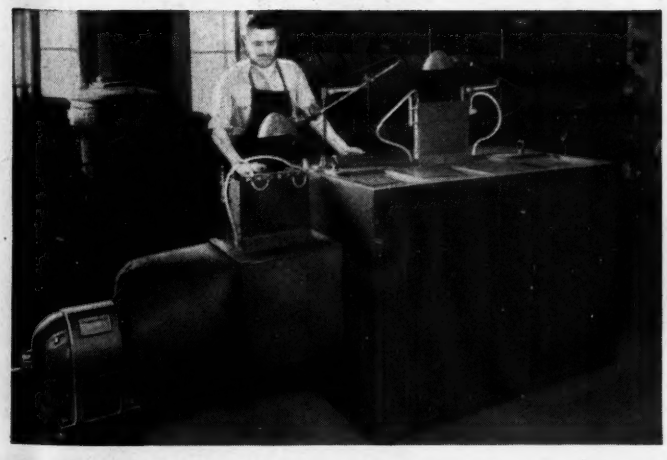
Tri-Clad motors have proved themselves cool-running even under such conditions. Their powerful, double-end ventilating system moves the air at controlled velocity for effective heat removal. The location and baffling of dual exhaust ports discourage recirculation.



Tri-Clad motor drives conveyor on wool dryer—Bigelow Sanford Carpet Co., Amsterdam, N. Y.

AIR-FLOW TESTS OF TRI/CLAD MOTORS LEAD TO PROTECTION FROM OVERHEATING

REG. U.S. PAT. OFF.

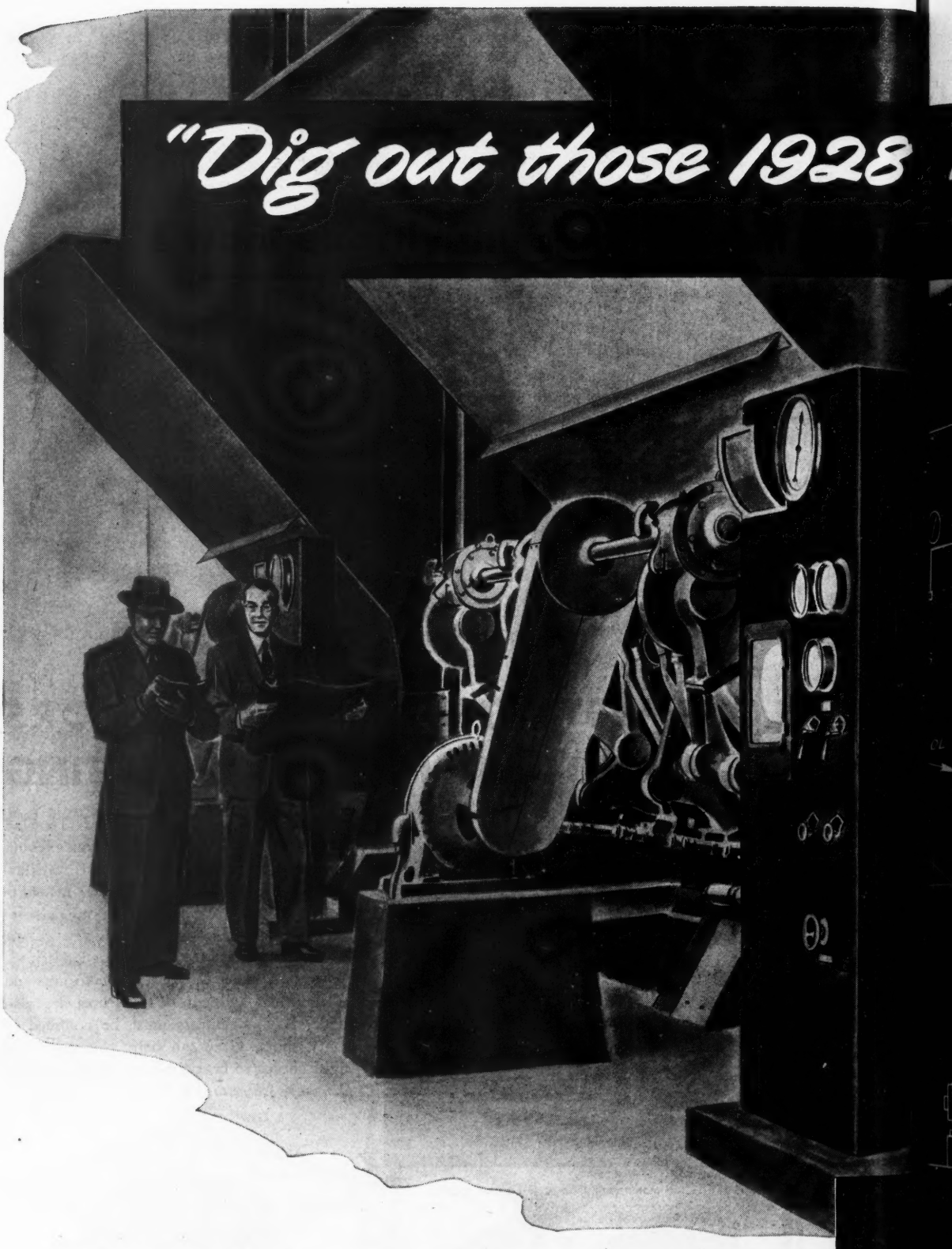


Plenum chamber test of Tri-Clad motor ventilation at G-E motor factory.

Before new types or sizes of Tri-Clad motors are approved for production, plenum chamber tests are conducted on the ventilating systems of sample models. These measurements serve as a check on previous calculations of the volume and velocity of air through the motor under different conditions. Other tests under load within enclosures and at abnormal ambient temperatures are also made. If your motors must be confined in stuffy spots, G.E. can help you make the right choice to beat the heat. *General Electric Company, Schenectady 5, N. Y.*

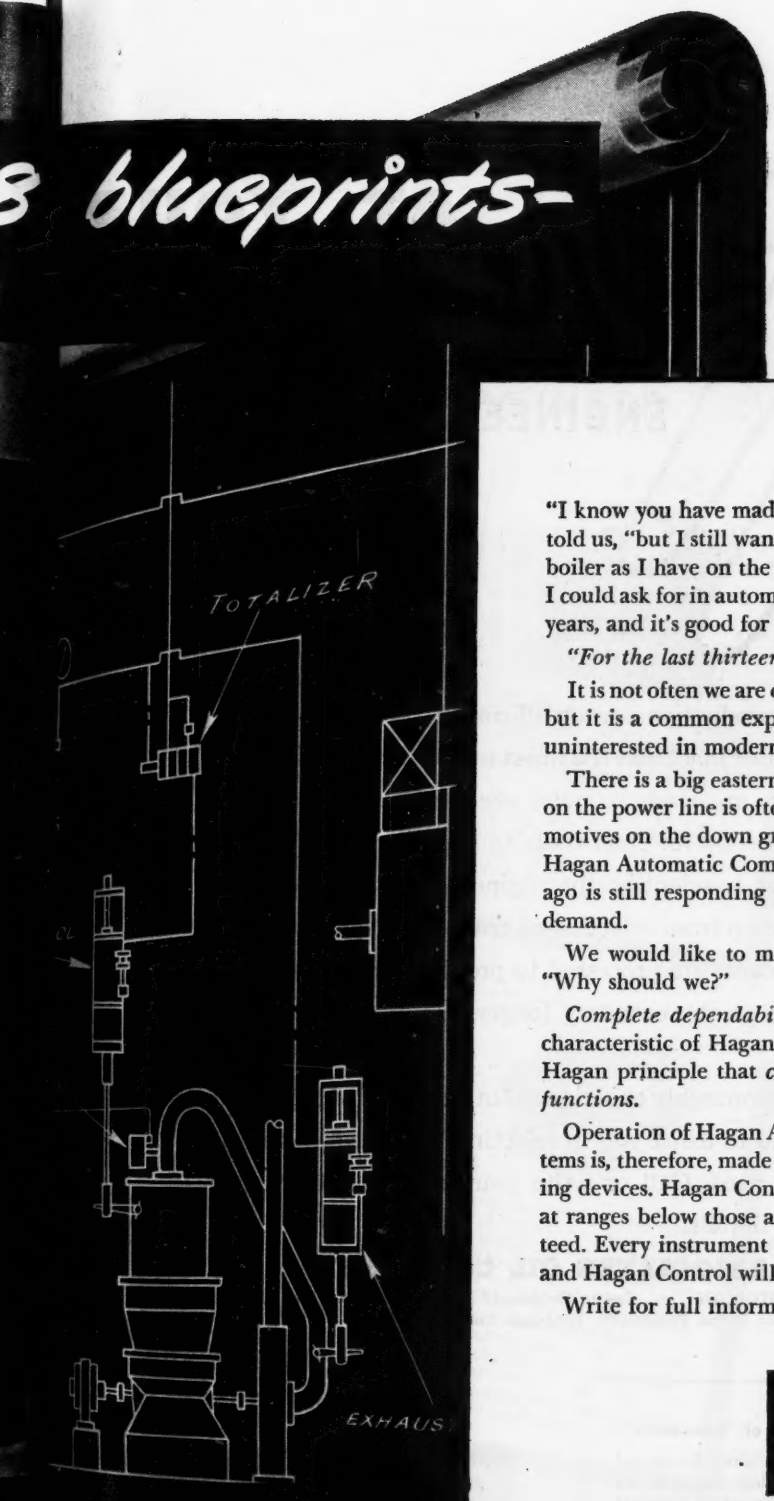
GENERAL ELECTRIC

Buy all the BONDS you can—*and keep all you buy*



HAGAN CORPORATION • HAGAN BUILDING • PITTSBURGH 30, PA.

8 blueprints-



"I know you have made improvements in the system," he told us, "but I still want exactly the same thing on the new boiler as I have on the old. That has given me everything I could ask for in automatic combustion control for sixteen years, and it's good for another sixteen."

"For the last thirteen years I haven't even touched it!"

It is not often we are called on to duplicate an old model, but it is a common experience to find users of old models uninterested in modernization.

There is a big eastern railroad, for example, where load on the power line is often less than zero when electric locomotives on the down grade feed power back into the line. Hagan Automatic Combustion Control installed 15 years ago is still responding perfectly to this wide variation in demand.

We would like to modernize that setup, but they say, "Why should we?"

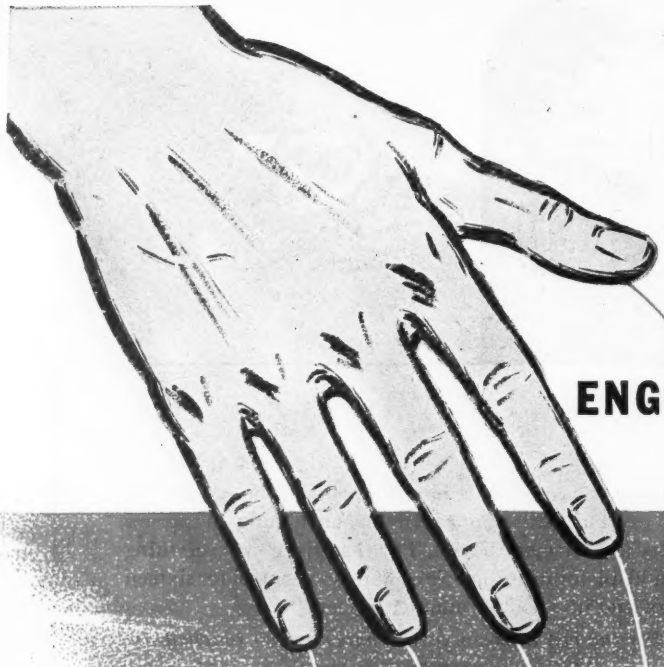
Complete dependability over a long period of years is characteristic of Hagan Control, primarily because of the Hagan principle that *control and recording are separate functions.*

Operation of Hagan Automatic Combustion Control systems is, therefore, made entirely independent of all recording devices. Hagan Control continues to function reliably at ranges below those at which meter accuracy is guaranteed. Every instrument on the panel can be out of service and Hagan Control will still be on the job.

Write for full information.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL



AT YOUR

ENGINEERED ANSWERS TO

FOR maximum production . . . top efficiency . . . lowest operating cost, give your machines the finest in lubricants—Tycol oils and greases. Tycol lubricants are made to meet every lubrication need of industry — from roll neck greases for steel mills to spindle oils for textile plants. Each Tycol lubricant is scientifically engineered to meet specific service conditions. At every step from selection of crudes to blending of the finished product, Tycol lubricants are processed to provide maximum lubricating efficiency which means greater economy, longer machine life for every type of equipment.

Tide Water engineers are thoroughly experienced in all phases of industrial lubrication. They will be glad to assist you in selecting the Tycol lubricant best suited to your specific need. Call or write your nearest Tide Water Associated office for further details.

TIDE WATER ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.
Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned immediately

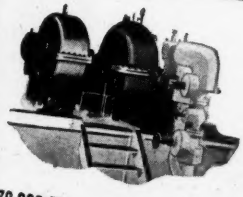
Have You Received Your Copy of "Lubricania"?

This informative handbook, "Tide Water Associated Lubricania", gives clear, concise descriptions of the basic tests used to determine important lubricant properties — Viscosity, Pour Points, Neutralization Number and many others. For your free copy write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

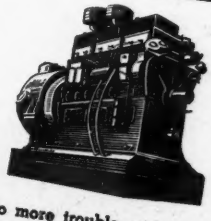
TYCOL
SCIENTIFICALLY

. . . Fingertips

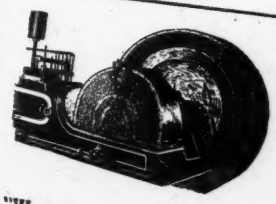
EVERY LUBRICATION NEED



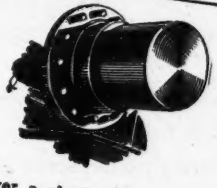
"70,000 Hours continuous operation . . . neutralization only .09." That's typical of the unusual performance achieved with Tycol Turbine Oil. Thanks to Tide Water's Edeleanu process, this oil has greater stability and resistance to emulsification . . . assuring more economy, steadier operation, smoother performance.



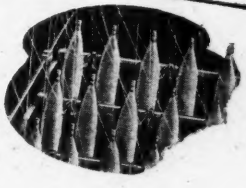
"No more trouble with sticking valves . . . costly delays and overhauls eliminated . . . engines giving better service . . ." — that's how one plant engineer describes the improved results gained with Tide Water Diesel Oil. It assures maximum economy — top performance — from every gallon of lubricant.



"We saved 33⅓% in oil costs when we changed to Tide Water E. A. Cylinder Oil." That report from a plant engineer typifies the kind of economical, trouble-free lubrication provided by Tide Water Steam Cylinder Oil in hundreds of plants. It gives better protection, promotes efficient operation and lowers lubrication costs.



"Never a single bearing overheated since we changed to Tide Water Green Cast Grease," says one chief engineer. No matter how severe the service, Tide Water Green Cast Greases assure better lubrication . . . less maintenance. The reason? They contain more high-grade cylinder oil — less soap — which means better performance in every application.



"300,000 Spindles operating for 13 years without a single lost tube" — that's a textile mill operator's way of pointing out the superior performance of Tycol Spindle Oils. For every textile application — from power plant to finishing — there's a Tycol Lubricant scientifically engineered for the job.

INDUSTRIAL TYCOL OILS-GREASES

INDUSTRIAL LUBRICANTS

ENGINEERED FOR EVERY INDUSTRIAL USE

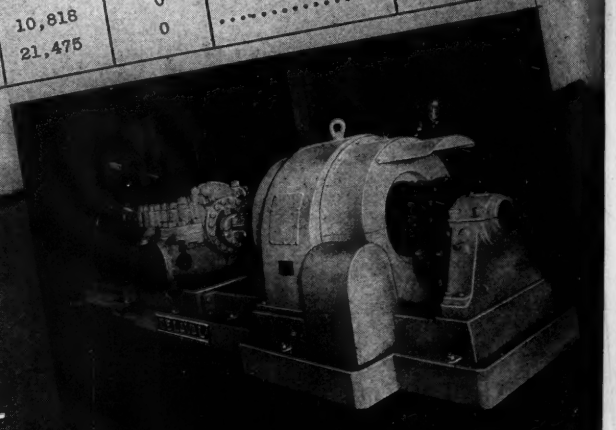
Look at the Record!

SERVICE RECORD—As of September 1, 1944

DE LAVAL PUMPS at _____

No.	Discharge Pressure psig	Suction Temp. °F.	Placed in Service	Total Service Hours	Outages Due to Pump	Cause of Outages	Approx. % Increase in Pump Power
14	1186	260°	12- 2-38	40,383	2	Replace ball locating bearing and shaft sleeves	Negligible
15	1186	260°	10-11-40	28,839	1	Replace shaft sleeves	Negligible
21	1186	350°	8- 4-39	10,818	0	.....	Negligible
16	1186	260°	1- 2-42	21,475	0	.....	5%

Capacity (all units).....1455 g.p.m.



of DE LAVAL HIGH-PRESSURE BOILER-FEED PUMP PERFORMANCE

Not one major trouble after as much as 40,000 hours of service!

The first of these units was installed in February, 1938; the most recent in February, 1942. All have demonstrated the satisfactory performance of De Laval boiler-feed pumps for high-pressure central station service.

Other important installations, operating at pressures up to 1600 psi and handling high temperature feed water, are operating with equal freedom from trouble, due in no small measure to the excellent performance of the De Laval automatic balancing device, the De Laval large clearance labyrinth wearing rings, and the sturdiness of De Laval solid end head construction.

3629

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG

MODERN DEVELOPMENTS OF GASKET RESEARCH

SPIRALWOUND . . .

This Metal-Asbestos "Sandwich"

Makes Sealing Warped and Pitted Flanges *A PICNIC*

SPIRALWOUND — an extremely popular gasket for standard or special flanges and boiler tube caps, hand-holes or man-holes —is composed of interlocking plies of preformed metal, cushioned with Asbestos strip, spirally-wound together.

Under compression, the central spring-like corrugation of the metal strip enables the gasket to seal warped or irregular flange faces and provides unequalled resilience to compensate for expansion and contraction in service. In addition to the multiple-sealing action of this metal strip, the Asbestos cushion also fills irregularities in flange faces to assure a tight closure.

SPIRALWOUND Gaskets have great mechanical strength, are highly resistant to corrosion and temperature extremes, have proper compressibility with relatively light bolting. Rugged construction permits re-use a number of times when seals must be broken.

This better gasket is another example of modern Gasket Engineering. To keep you posted on the latest gasket developments, we will be glad to send you a series of technical bulletins containing original data resulting from continuous research in the unique Goetze Laboratory. Please write on your company letterhead, mentioning your position.

GOETZE GASKET & PACKING CO., INC.
17 ALLEN AVENUE, NEW BRUNSWICK, NEW JERSEY

LOWELL THOMAS Speaks on New Gasket Film

Now available to employee groups, technical societies, engineering schools and other organizations throughout the country, this new 35-minute Kodachrome film, "Only a Gasket," tells why these are the "Biggest little things" in modern Industry. Write for full information.

Goetze for GASKETS

"America's Oldest and Largest Industrial Gasket Manufacturer"

K & M "Century" ASBESTOS CORRUGATED makes this a *well built* plant

Throughout the country, thousands of plants like this one have been getting years of satisfaction from "Century" Asbestos Corrugated and Flat Lumber. There must be good reason for this . . . in fact, there are six. Here are the special features of "Century" Asbestos Corrugated and Flat Lumber:

1. It is a tough material . . . being a combination of asbestos fibre and portland cement, produced under tremendous hydraulic pressure.

2. It has a pleasing, clean-cut appearance . . . needs no surface finish.

3. It is an amazingly adaptable material.

4. It is economical because it is maintenance free.

5. It is completely fire resistant.

6. It comes in 19 different lengths.

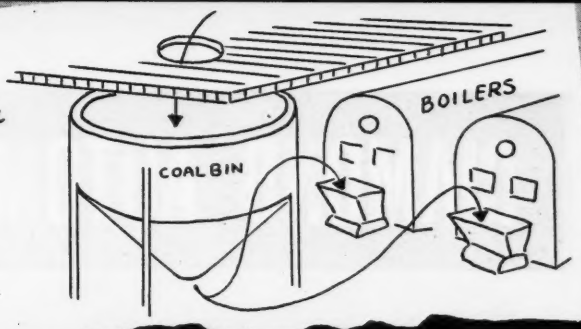
K&M "Century" Asbestos Lumber, in flat or corrugated form, is suited for plant additions and the redesigning of existing buildings. You'll save time and money, and avoid risk, when you build with "Century." Let us help you with your particular problem, whether it is an immediate one or concerns future plans now on the drawing board.

KEASBEY & MATTISON

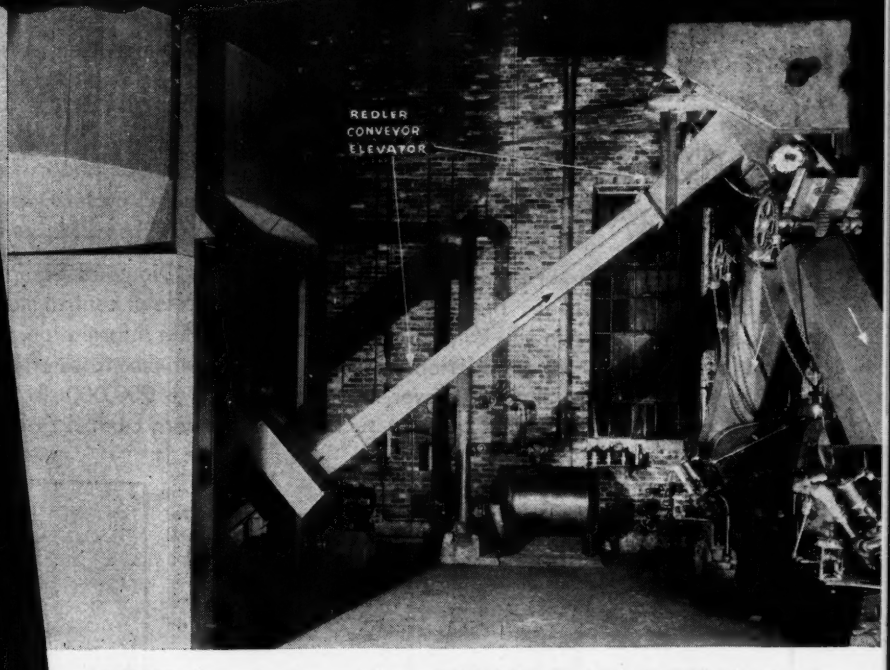
COMPANY • AMBLER • PENNSYLVANIA

The Problem—

To install a coal conveying system to fit cramped quarters of small boiler room and keep room clean —



HOW S-A ENGINEERS "Killed Both Birds with One Stone"



REDLER shown elevating coal from cylindrical bin to point in front of stoker hoppers where two-way spout regulated by S-A Rack and Pinion Gates distributes required amount of coal to each stoker.

In these cramped quarters, compactness of coal conveying equipment was essential and an S-A REDLER Conveyor-Elevator, requiring a very minimum of space compared to conventional conveyor types, was the answer. Coal is conveyed from bin to *two* stoker hoppers with sealed REDLER casings preventing the escape of coal dust into the boiler room.

When handling problems are made more complicated by local conditions . . . such as the close quarters in this boiler room . . . access to the *right equipment installed right* pays extra dividends. Write for information on a modern REDLER Coal Handling system for your plant.

STEPHEN S-A DAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS

LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

DIAMOND AUTOMATIC SEQUENTIAL

When a boiler is equipped with Diamond Automatic Sequential Air Puff Soot Blowers, none of the situations you see illustrated at the right can happen. In the first place, there is no attendant because the entire soot blowing system is operated by simply opening a valve on master controller or by pushing a "start" button on a program panel which can be a part of the boiler and turbine control board.

Then, being automatically controlled, the soot blowers always operate in the same sequence and with the same blowing time. No blower unit can be overlooked or incorrectly operated. Should it ever be found necessary to change the blowing sequence, it is easily accomplished by a simple change on the master controller.

The compressed air—having a greater density than steam—provides theoretically better cleaning. The air is discharged from the element nozzles in a series of short puffs with substantial pauses between. Spreading the cleaning cycle over a longer period of time permits use of a very small compressor.

This Diamond equipment has been in very successful central station use since 1940. For further information, write for Bulletin No. 956 which illustrates and describes an installation on a 900,000 lb/hr boiler in a modern eastern central station.

Other Features

SAVES LABOR

—no attendant needed to drain piping, warm it up and operate each individual blower.

NO FEED WATER MAKEUP

—using compressed air instead of steam.

SAVES FUEL

—uses only ⅓ to ⅔ of energy from coal pile that is needed for steam blowing.

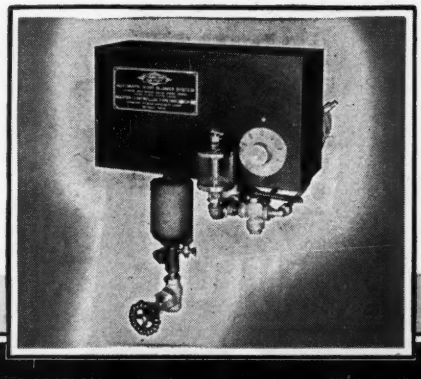
ELIMINATES STACK DISCHARGE NUISANCE

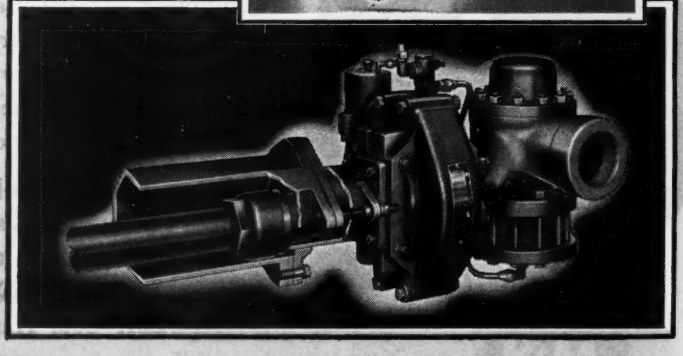
—intermittent operation expels soot from boiler in small quantities.

REDUCES MAINTENANCE

—experience on boilers in operation since 1940 proves maintenance unusually low.

(Right) Master Controller which automatically controls the sequence and blowing time of Diamond Air Puff Soot Blowers (see below) having elements permanently installed inside the setting.

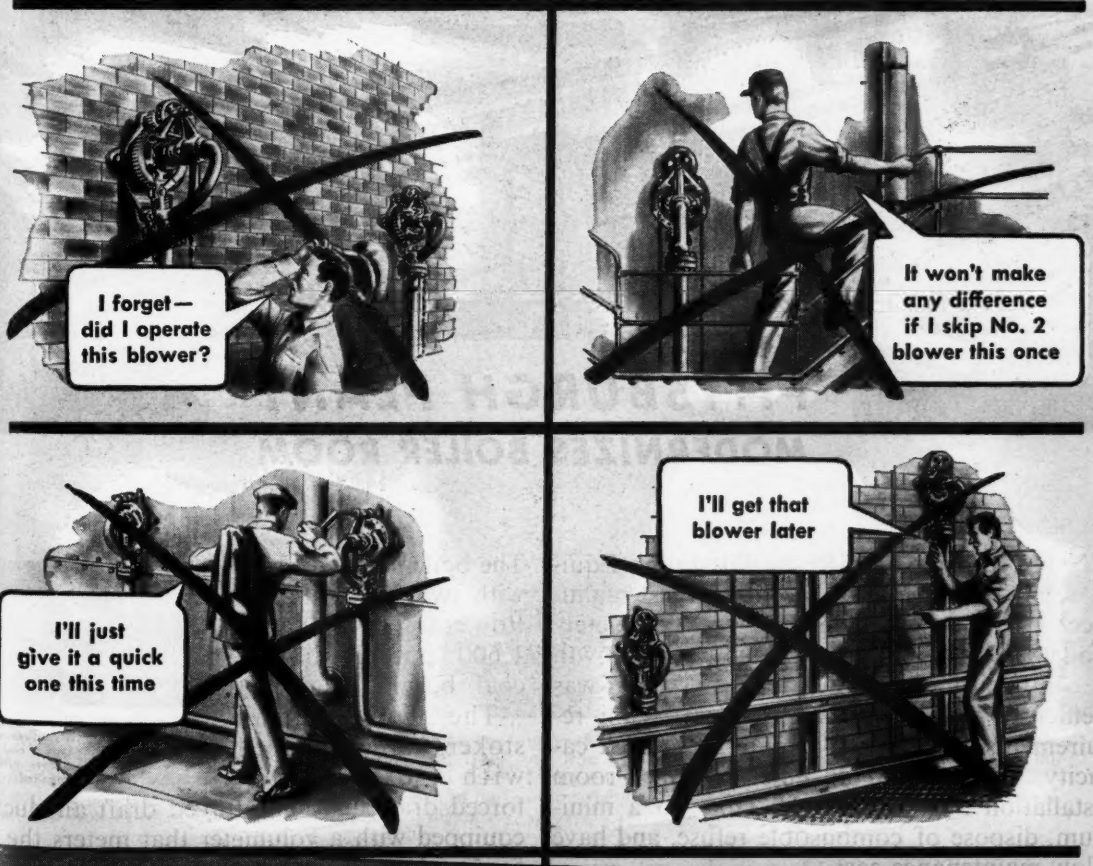




DIAMOND POWER

"Air Puff" SOOT BLOWING

Eliminates THE HUMAN ELEMENT
and Assures
CORRECT BOILER CLEANING


I forget— did I operate this blower?
It won't make any difference if I skip No. 2 blower this once
I'll just give it a quick one this time
I'll get that blower later

SPECIALTY CORP. DETROIT 31, MICHIGAN
DIAMOND SPECIALTY LIMITED • Windsor, Ontario

"Our IRON FIREMAN

save 20% in coal, 30%

—estimates J. R. Burke, maintenance foreman, Pittsburg

PITTSBURGH PLANT MODERNIZES BOILER ROOM

IN the summer of 1940 the Pittsburgh Equitable Meter Co., the world's largest manufacturer of water and gas meters, completely modernized its boiler plant. Due to the growth of company business, the old boiler plant was inefficient and inadequate to meet steam requirements, even in the handling of rated capacity. They wanted an efficient boiler room installation that would hold labor to a minimum, dispose of combustible refuse, and have a low maintenance cost.

To meet these requirements the company decided to install two Pacific No. 75-S-1 boilers having 2,143 square feet of heating surface and an E. D. R. rating of 36,431 square feet. The boilers are stokered with two Iron Fireman Poweram stokers of 1,600 pounds hourly coal burning capacity.

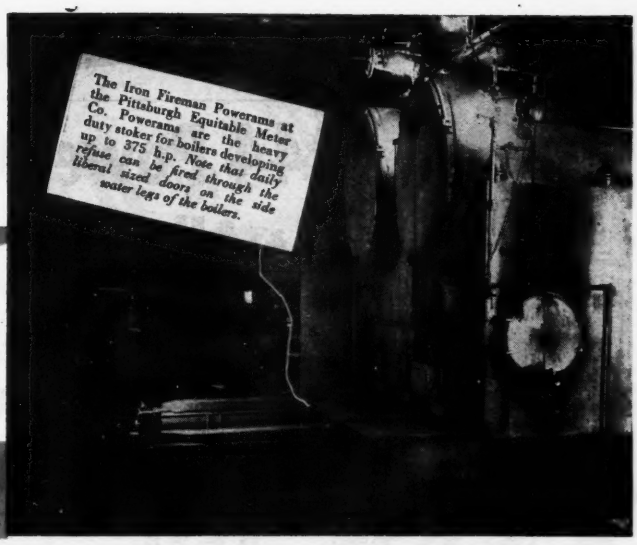
The Iron Fireman exclusive volumeter is highly responsive. Regardless of fuel bed conditions or the type of coal used, the Volumeter will always give the volume of air required.

The Iron Fireman stokers are equipped with motor driven forced draft fans. The forced draft air duct is equipped with a volumeter that meters the air for combustion in proper volume for the fuel burning rate. Variations in fuel bed resistance are automatically compensated for with no deficiency or excess of air, thus making possible high combustion efficiency.

STOKERS

%in labor"

Equitable Meter Company

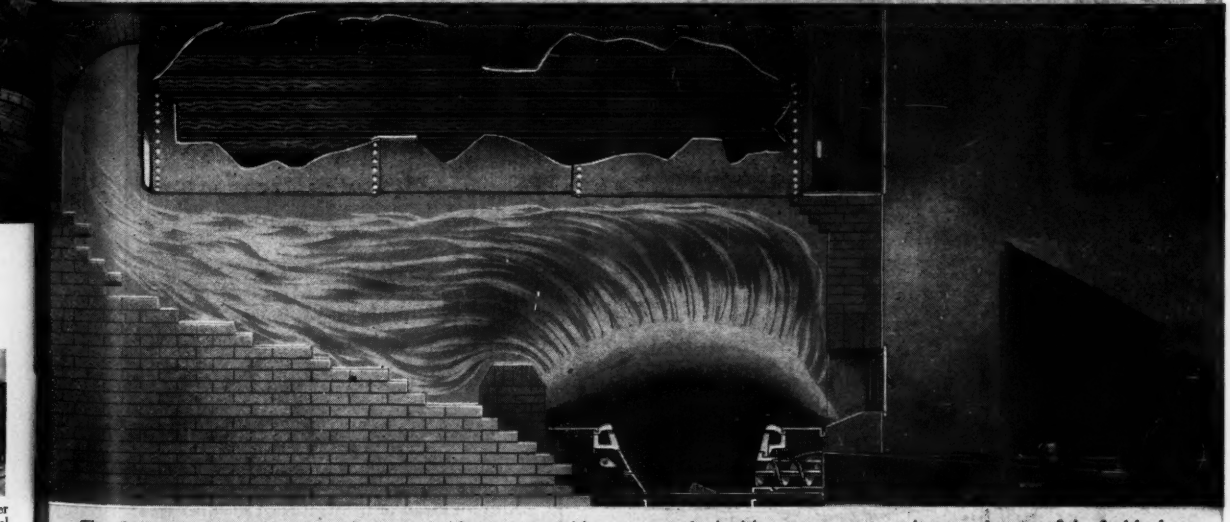

The Iron Fireman Powerams at the Pittsburgh Equitable Meter Co. Powerams are the heavy duty stoker for boilers developing up to 375 h.p. Note that daily refuse can be fired through the liberal sized doors on the side water legs of the boilers.

THE high combustion efficiency of the Iron Fireman stokers is responsible for a fuel saving of 20% over hand-firing at this plant. The Iron Fireman Poweram stokers installed here are of an extended design with a distance of 16 feet from the center line of the retort to the center line of the coal hopper. The extended design was selected so the coal hoppers could be filled directly from the coal bin, thus avoiding the wheeling of coal from the bin to hoppers located at the boiler front. This design helped to make the 30% reduction in labor.

The extended arrangement keeps the boiler room clean. There is no wheeling of coal, piling of it in front of boilers or shoveling.

Iron Fireman Stokers Available

Iron Fireman commercial and industrial stokers are in full wartime production. Our nationwide organization of qualified engineers and dealers will make a free survey to determine what Iron Fireman can do for you. Write the Iron Fireman Manufacturing Company, 3847 West 106th Street, Cleveland 11, Ohio.



The Iron Fireman Poweram design combines non-packing screw-conveying with reciprocating retort distribution. The reciprocating blocks in the bottom of the retort eject fuel from the retort and properly distribute it over the burning area of the stoker. The Iron Fireman slowly preheats the coal, bringing it up to the ignition temperature as it nears the top of the fuel bed. An Iron Fireman fired boiler is never choked with coal, nor is the fire allowed to unduly die down. Automatic controls insure the fuel supply necessary for current steam demands.

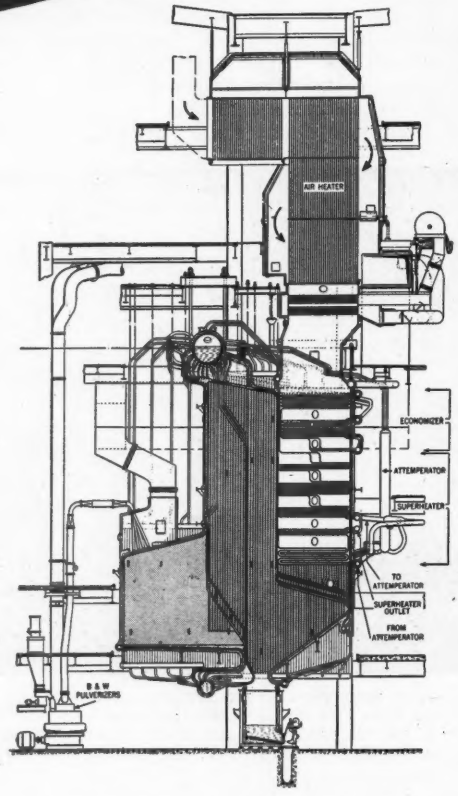
IRON FIREMAN

THE IRON FIREMAN

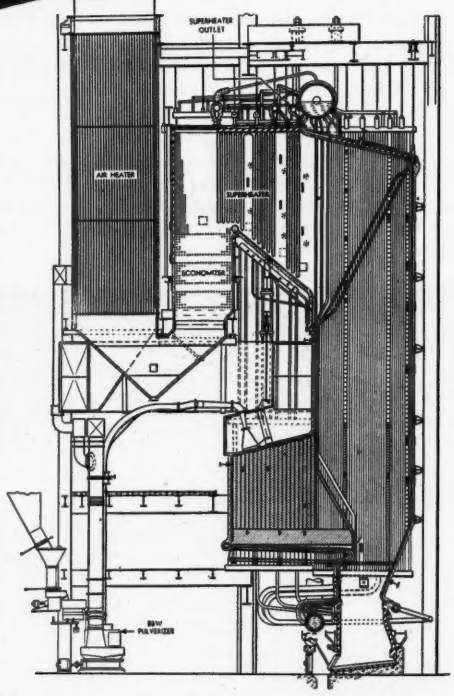
Automatic Coal Stokers

1944 Power Output At All-Time High

NEW RECORDS ARE AN



Open-Pass Boiler in an eastern central-station—capacity 900,000 lb. steam per hr.



Radiant Boiler in an eastern central station—capacity 900,000 lb. steam per hr.

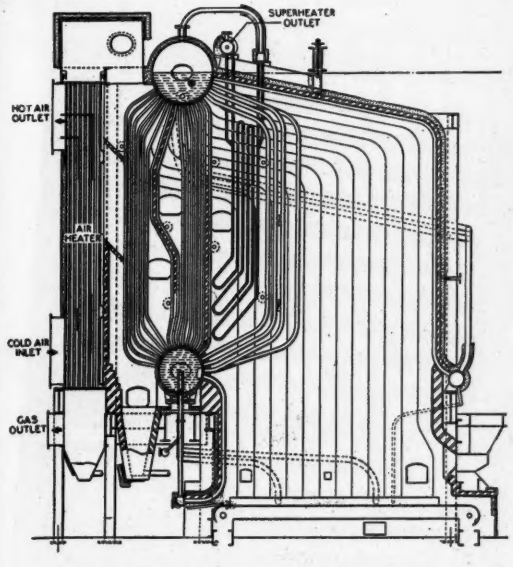
BUY WAR BONDS!

★ ★ ★

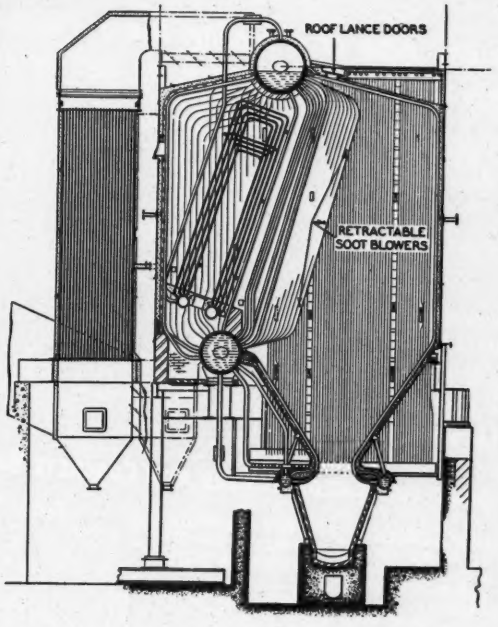
BUY MORE THAN BEFORE

G-295-T

OLD STORY WITH B&W BOILERS



Stirling Boiler in a western manufacturing plant—capactiy 115,000 lb. steam per hr.



Integral-Furnace Boiler in a mid-western steel plant—capacity 169,000 lb. steam per hr.

To managements, engineers, and operating personnel of public utilities and industrial power plants throughout the nation, B&W too, says "WELL DONE" for another year of distinguished war-time achievement.

Your accomplishment in meeting the increased war-urgent power demands for war production and civilian consumers, also added another outstanding chapter to past performance records of B&W Boilers. By providing a large part of your 1944 steam requirements, B&W installations—Radiant, Open-Pass, High-Head, and Integral-Furnace—continued to demonstrate their high availability for service, reliability, and economical performance under unprecedented operating conditions. Along with these more recent B&W designs, Cross-Drum and Stirling boilers also upheld the impressive performance for which they have been so well known for decades.

This proved ability of your B&W boilers to deliver large blocks of steam reliably and economically, even under adverse circumstances, is a factor to keep in mind when boilers are needed for future replacements or expansion. It is an indication of how closely B&W designs are matched to the requirements of each job. It is a good reason why you will want to draw again on our long experience in designing, building, and applying steam-generating equipment—experience which cannot be written into specifications or shown on blue-prints, but which is inherent in every B&W Boiler.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.

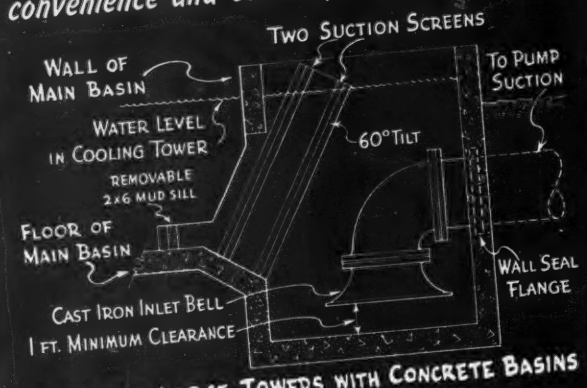
85 Liberty St., New York 6, N. Y.

Cooling Tower DOs and DON'Ts

-by MARLEY (No. 6 of a series)

POINTERS ON THE WATER CIRCUIT

In any type of a cooling tower these items are important to operating convenience and economy, as well as efficiency:



SUMP FOR LARGE TOWERS WITH CONCRETE BASINS

High Screen extending above water. Sectionalized for easy removal, cleaning & replacement
Safety Overflow with "umbrella" to shed spray
Anti-Cavitation Plate
Water Level
Float Valve
Sump belled to minimize friction
Basin Floor
Basin Side Wall

SUMP FOR SMALL TOWERS WITH WOOD OR STEEL BASINS

ACCESSIBILITY—Are all parts requiring periodic inspection, cleaning or adjustment easy ro "get at"?

PIPING & DISTRIBUTION SYSTEM—Are supply and return lines of ample size? Does layout of risers, headers and arms offer least possible friction and require the least lift practicable? If tower loadings or local wet-bulb vary much, is the system adequately sectionalized and is water distribution fully effective at various loadings in each section independently? Are nozzles, if used, of non-clog design with large orifices?

PUMPS—Are pumps of adequate capacity, advantageously located? Are they needed on both supply and return? Is a "stand-by" advisable?

VALVES—Are there enough valves and properly located for convenient flexibility of tower operation (i.e. to cut off or cut down water to the separate sections, to partially or totally by-pass the distribution system in cold weather, etc.) thus saving pumping cost when tower's maximum performance is not required?

BASIN—Is the catch basin of ample depth, with automatic float valve for make-up? Have ALL factors governing design and material (concrete, steel or Redwood) been OKed by both tower manufacturer and purchaser?

SUMP—Is the small tower's sump set leak-proof in the Redwood or steel basin, screened to keep out debris, belled to ease flow, with anti-cavitation plate to prevent air intake? Does the large tower's concrete sump have double screens (so one remains in place while other is being cleaned), is area through screens ample and is the suction bell lower than the main basin's floor?

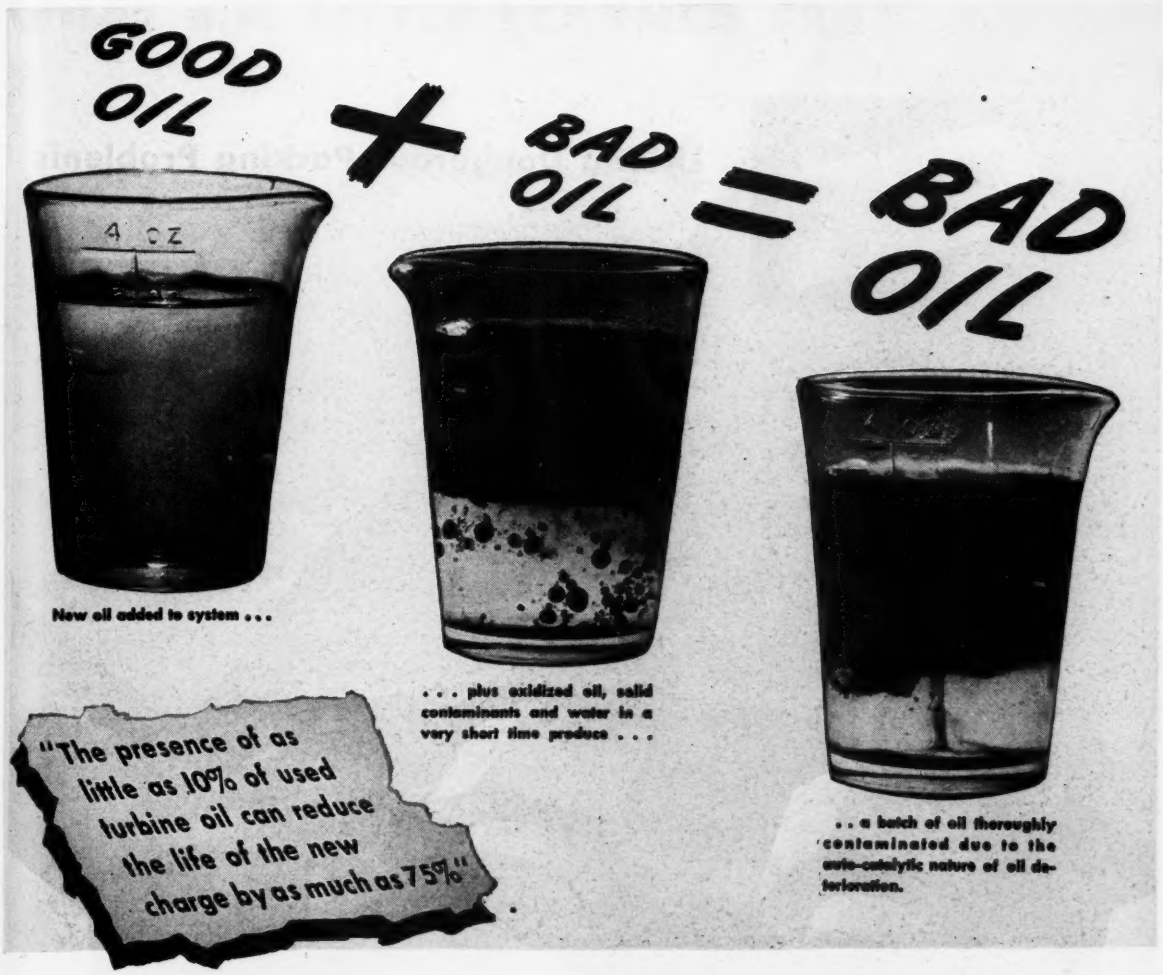
MARLEY COOLING TOWERS

15-A

DO YOU KNOW—the Marley "Double-Flow" is the only mechanical draft cooling tower having a completely *external* distribution system; all parts easy to see and reach even while the tower is operating.

This unique open distribution system permits water quantities to be varied widely in each "cell" individually. Extremely simple piping, extremely low pumping head.

THE MARLEY COMPANY, INC. KANSAS CITY, Ks.


GOOD OIL
+
BAD OIL
=
BAD OIL
4 oz
New oil added to system . . .
. . . plus oxidized oil, solid contaminants and water in a very short time produce . . .
. . a batch of oil thoroughly contaminated due to the auto-catalytic nature of oil deterioration.
"The presence of as little as 10% of used turbine oil can reduce the life of the new charge by as much as 75%"

KEEP YOUR TURBINES *SWEET-RUNNING* WITH THE NEW SHELL CLEANING PROCEDURE

It's open-and-shut—no if's, and's, or but's . . .

Add clean oil to dirty oil and you get—*dirty oil.*

Add clean oil to a lubricating system that's contaminated with sludge, rust, metal chips and other foreign matter and you get—*dirty oil.* **Either way, you lose.**

In fact, unless the system is thoroughly clean, you're throwing away good dollars every time you install a new oil charge.

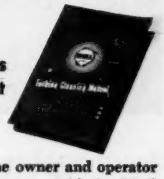
The new Shell Turbine Cleaning Procedure saves time and money; it assures thorough cleaning, increased oil life, less frequent shutdowns, better over-all operation.

The procedure is simple, foolproof . . . first a solvent cleaner—Shell Turbo Cleaner. This dissolves the products of oil deterioration, helps remove contaminants.

Then, a displacement oil with final draining to wash away the used Shell Turbo Cleaner, to insure complete cleaning.

Phone, wire or write Shell Oil Company, Inc., 50 W. 50th St., New York 20, N. Y. or 100 Bush Street, San Francisco 6, Calif.

Send for this booklet now!



Every turbine owner and operator should have a copy of the Shell Turbine Cleaning Manual. It tells how—simply and clearly—to keep turbines clean and sweet-running.

SHELL

SHELL TURBO OIL

Licking Dangerous Packing Problems

Superheated steam, poison gases, corrosive fluids, acids, and other hazardous fluids hold no terrors for R/M packings.

R/M special packings handle the most dangerous installations with perfect safety.

Positive performance is guaranteed by the more than forty years of experience that R/M has had in all branches of the packing field.

You can get R/M packings now for your safety hazards or for those every-day jobs where you need good, reliable packing that lasts. More than seventy different types are available for every industrial use.

It's "Packed with Satisfaction"—When You Use R/M

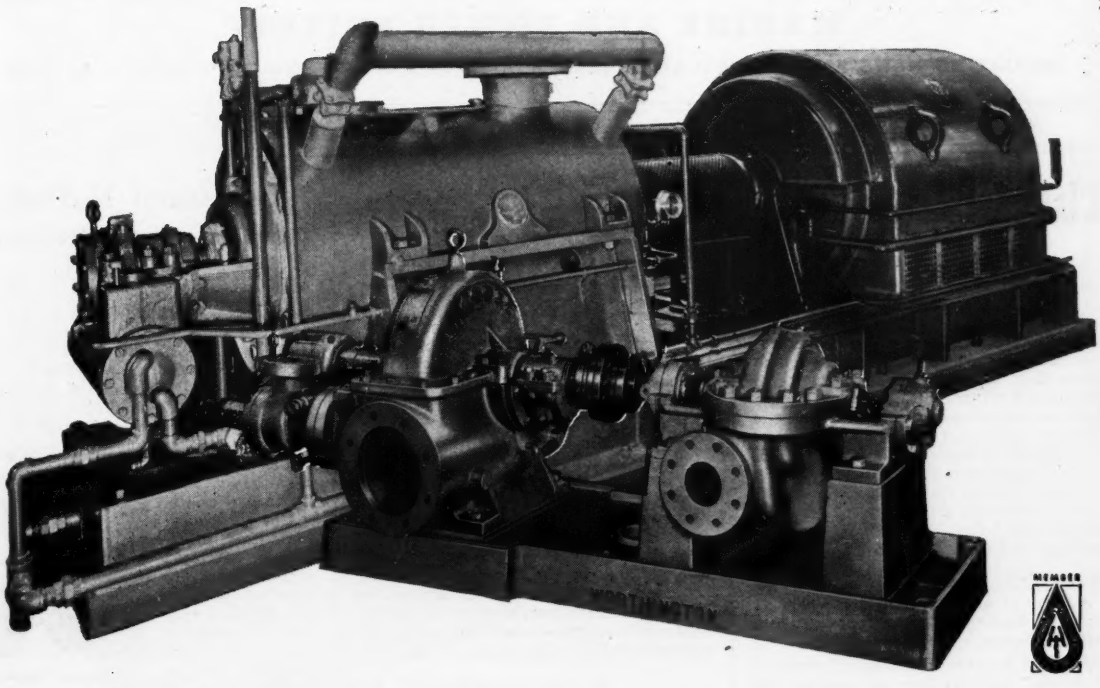
INDUSTRIAL SALES DIVISION

RAYBESTOS-MANHATTAN

INCORPORATED

Manheim, Penna. · Bridgeport, Conn.
North Charleston, S. C. · Passaic, N. J.

WHAT MR. LITTLE LEARNED FROM MR. BIG



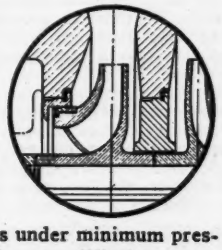
Explains Why Worthington Low Pressure Boiler Feed Pumps Give You More Value For Your Money

"Mr. Little"—the low pressure boiler feed pump—learned a lot at Worthington from high-pressure "Mr. Big".

The same pump engineering ability that built the first high pressure boiler feed pumps in the U. S. (above 1200 p.s.i.) . . . and made them able to operate 30,000 hours—and more!—without major or minor overhaul . . . built the low pressure centrifugal pump (type UB2—150 to 500 p.s.i.) illustrated above.

Investigate, in Bulletin W-318-B11B, its many advantages. Find out how *balanced design* eliminates end thrust . . . how *"elastic seal"* rings prevent interstage leakage . . . how its *rigid center support* prevents misalignment from expansion. Write us, or telephone our nearest district office. *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

WORTHINGTON'S "ELASTIC SEAL" RINGS PREVENT PUMP TROUBLES BEFORE THEY START



Interstage leakage (a common cause of pump breakdowns) is definitely ended with Worthington's exclusive "Elastic Seal" Rings on the job.

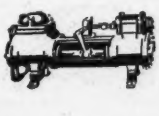
Other low-maintenance construction features: accessible, horizontally-split casing . . . both stuffing boxes under minimum pressure...simple rotor construction...no diffusion vanes.

WORTHINGTON *BEHIND THE NAME*

CP4-19

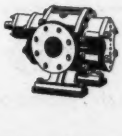
WORLD'S LARGEST MANUFACTURER OF PUMPS

STEAM



POWER

ROTARY



VERTICAL TURBINE

CENTRIFUGAL

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

The Influence of pH on the Corrosion Rate

The term pH (hydrogen ion concentration) has come to us from the biologist who knows that life processes of all types of organisms are markedly influenced by the hydrogen ion concentration present in the solutions which surround them. Since certain species of organisms can survive in only very narrow range limits of hydrogen ion concentration the biologist has developed a mathematical formula for expressing the activity of a solution with respect to its hydrogen ion concentration.

For example:

A pH of 14 means that .00000000000001 grams of Hydrogen ions are present in a litre of solution.

A pH of 7 means that .0000001 grams of Hydrogen ions per litre of solution are present.

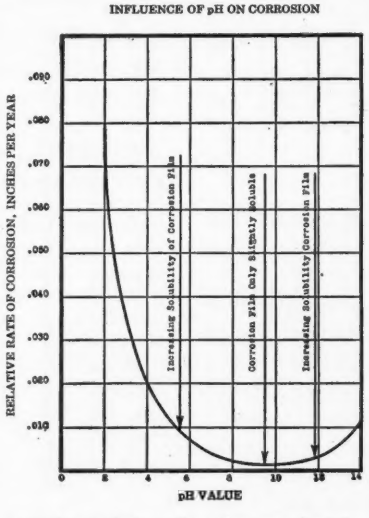
This value is the pH value for pure uncontaminated distilled water at room temperature. pH4 means that .0001 grams of Hydrogen ions are present in 1 litre of liquid. A reduction of several numbers on the pH scale may mean more than a thousand fold increase in Hydrogen ion content with correspondingly greater activity.

The pH factor by itself, does not tell the whole story. The character and quantity of ions other than Hydrogen present in the solution must, of course, also be taken into consideration. In other words, the pH value should be used in conjunction with the chemical analysis of the water or liquid. The presence of various salts such as chlorides, nitrates, sulphates, etc., and gases such as ammonia, hydrogen sulphide, carbon dioxide, etc., are very important in their influence on corrosion.

Since control of operations is an important function of both the power plant and marine engineer, the use of the pH value has become an essential part of his water control analysis. For example, boiler feed water is usually treated before it is fed into the boiler. This is done because a water with the proper composition will be less scale forming and less corrosive than before treatment. As far as steam condensate is concerned, periodic checks on its pH value and composition are helpful and necessary to detect the entrance of harmful impurities that may attack metals.

The approximate curve showing the influence of the pH value of fresh water on corrosion of copper base alloys appears in the chart below. The general shape of this curve may be considered as fairly typical. The flat portion and the slopes of the curve vary with the character of the metal and the nature of the corrosive solution.

The curve shows in a general way what may be expected when a change in pH value takes place. For example, a drop in pH value may indicate a rise in corrosion rate. More specifically, clean sea water normally has a pH value of more than 8.0 whereas harbors, estuaries and bays may have appreciably lower pH values because of contamination from sewage and factory wastes. The higher corrosion rates of harbor waters therefore indicate the need for more



corrosion resisting alloy than required for clean ocean water.

It must be taken into account that a natural fresh water with a pH value of 7 to 8 usually is much less corrosive than sea water with the same pH value because of the presence of much mineral matter (salts, etc.) found in sea water. It is for this reason that the average life of a condenser tube in a power plant using fresh water is much longer than that of the same alloy with clean sea water. Polluted sea water is considerably more corrosive than clean sea water.

The pH values if checked periodically are an indication of uniformity of water supply. Changes in value should be looked upon with suspicion and investigated. More and more attention is being paid to water analysis since its importance is being more widely realized.

More detailed information on the subject of pH values and corrosion in general are dealt with in Bridgeport's Condenser Tube Manual. Write for your copy if you are planning to retube your condensers or if your tubes are not standing up as long as they should.

Technical Bulletin on Duplex Tubing

Duplex Tubing was developed to overcome corrosion problems too severe for a single metal or alloy. By treating such a condition as two separate corrosion problems, and selecting the material best for each, it is possible to combine two such materials into one tube. Moreover, Bridgeport's method of manufacture produces a close mechanical contact between the two materials without seriously interfering with heat transfer properties.

One of the most important applications described in the bulletin concerns ammonia refrigeration systems with copper for the water side and mild steel for the ammonia side. This combination is standing up much longer than steel pipe, which rusts away. Other combinations described in the bulletin are: Bridgeport Admiralty, Copper, Red Brass, Brass, Cuzinal, Cupro Nickel or Duronze IV combined with such materials as Carbon Steel, Stainless, Aluminum or Monel Metal.

Cross-section drawings illustrate methods of installation for low and high pressures, and for different liquid velocities. The problem of galvanic corrosion between the tube sheet and the tubes is covered, and corrective methods are described.

This Technical Bulletin on Duplex Tubing may be obtained free of charge by writing to Bridgeport Brass Company on company stationery.

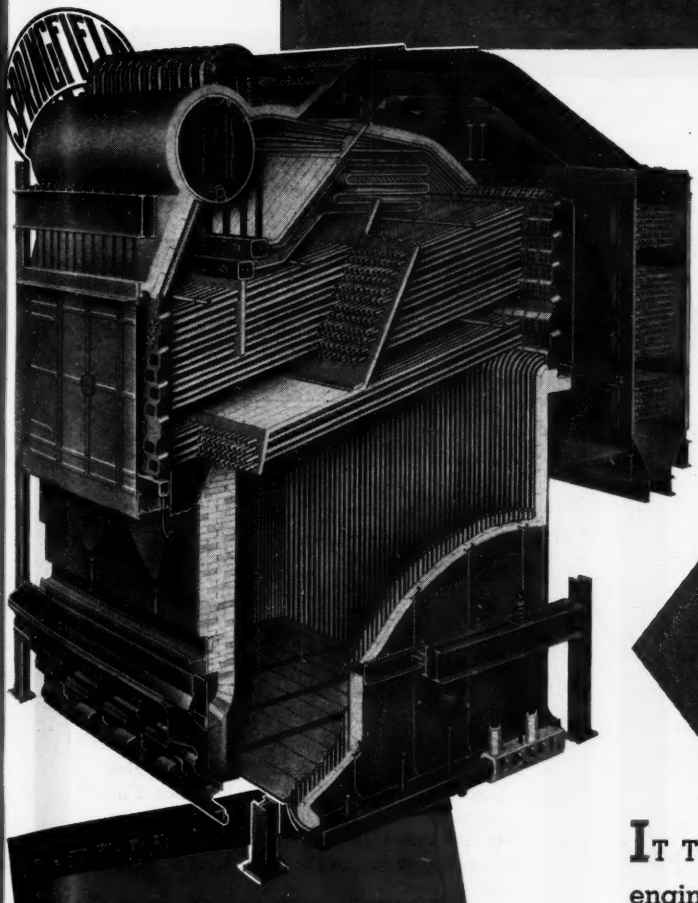
Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

ESTABLISHED 1865



CAST STEEL HEADERS — permit tighter rolled tube joints.

SECTIONAL ONE PIECE BAFFLES —make a rugged, permanently tight baffle wall.

STAGGERED GROUP TUBE ARRANGEMENT — gives maximum heat absorption, producing higher efficiency.

SECTIONAL HEADER DESIGN — saves 30 to 60 days erection. Tubes rolled in headers at factory.

PERMANENTLY TIGHT BAFFLES —records show as much as 20 years without maintenance.

SINGLE CROSS DRUM—designed for fast, dry steaming.

It took thirty years...

...to design this boiler!

IT TOOK OVER 30 YEARS and plenty of engineering courage to develop the modern Springfield boiler. In order to bring about higher efficiencies, faster steaming, greater responsiveness to load change, longer life of parts with less frequent and easier maintenance, Springfield engineers had to depart from previous concepts of design.

The fact that the first modern high ratings were accomplished with Springfield boilers is evidence of the success of this course.

For information on units to meet your requirements, write: SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Ill.

SPRINGFIELD

STEAM GENERATING UNITS

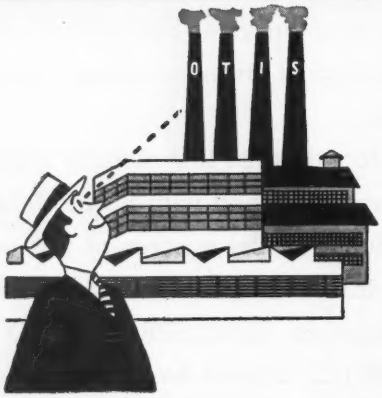
SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

THE WAR...
YOUR ELEVATORS...
AND YOUR EYES

1. On flat-tops, battleships, and cruisers, Otis precision-built elevators have been and are today serving the United States Navy on the seven seas. From our experience in providing this equipment have come marked improvements in design, new manufacturing techniques, and a store of knowledge destined to provide still further improvements in Otis Elevators after the war.

2. Today, therefore, when planning the modernization of your present equipment, give particular consideration to Otis Elevators. This company, with 244 offices throughout the United States, is in a position now to cooperate with you in the preparation of plans and surveys.

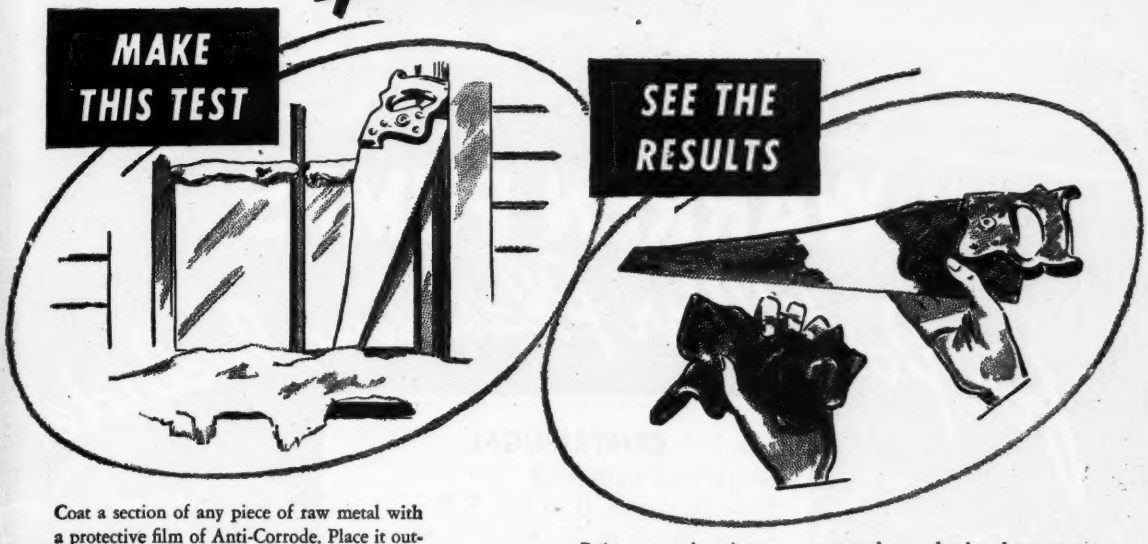


3. *So, keep your eyes on Otis.* In the days ahead, this company, through the continued use of advanced methods and new skills, will, as in the past, be ready to assure you of the last word in efficient and economical vertical transportation.

Remember, there is an Otis representative as near as your telephone. He will be glad to discuss future plans for new elevator or escalator installations or the modernization or maintenance of existing equipment. Call him today.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

How to *prevent* Corrosion



Coat a section of any piece of raw metal with a protective film of Anti-Corrode. Place it out-of-doors, and leave exposed to the elements.

Rain, snow, changing temperature, dust and grime have eaten into and oxidized the unprotected metal. But note surface under Anti-Corrode film—bright and unharmed, in its original state.

CITIES SERVICE ANTI-CORRODE is a safe rust and corrosion preventive that brings amazing results. It is a reliable safeguard against corrosion of metals in any form or state of finish—whether in storage or in transit. Anti-Corrode forms a tenacious, durable film that is impervious to moisture and the more common gases prevalent in the atmosphere. And, since it contains lubricating material, it need not be removed in drawing operations. Anti-Corrode is made in several grades to meet specific requirements and severest tests. It is economical, easy to apply and can be removed with kerosene or any petroleum solvent.

This TEAM Will Save You Money and Materials

Recently, we announced the development of Cities Service Rust Remover, and responses to the demonstration offer far exceeded our expectations. Rust Remover, of course, *removes* rust. Anti-Corrode is designed to *prevent* rust and corrosion. Together, they will safeguard your equipment and war production—for the duration!

Take advantage of this FREE ANTI-CORRODE demonstration offer
Mail this coupon today!

(Available only in Cities Service marketing territory EAST of the Rockies.)

CITIES SERVICE OIL COMPANY
NEW YORK · CHICAGO
ARKANSAS FUEL OIL COMPANY

CITIES SERVICE OIL COMPANY
Room 230, Sixty Wall Tower, New York 5, New York

Gentlemen: I would like to test Anti-Corrode on my own equipment FREE OF CHARGE. Please send me the details.

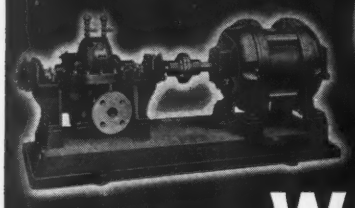
Name_____

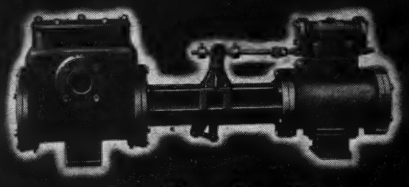
Company_____

Address_____

City_____ State_____

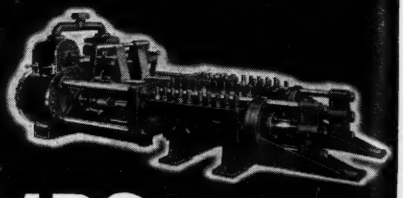
Warren Two-Stage Volute Centrifugal Pump





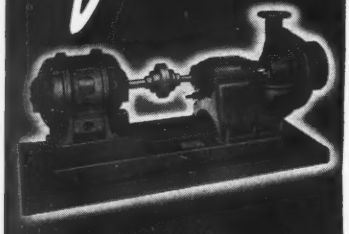
Warren Steam Heat Vacuum Pump

Warren Horizontal Duplex Hydraulic Pump



WARREN PUMPS

for Post-War Planning Include:



Warren Type "L" Single-Stage Single-Suction Liquor Pump

CENTRIFUGAL

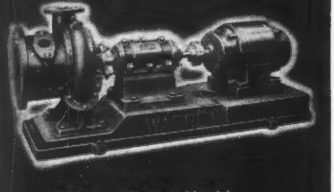
Single and multi-stage
Pressure range: 0 to 850 P. S. I.
Capacities: 0 to 36,000 G. P. M.
Types: Horizontal & Vertical
Impellers: Open or enclosed
Casings: Horizontal or Vertical Split, cast iron or bronze
Bearings: Sleeve or ball-bearing

RECIPROCATING

Horizontal and Vertical single piston
Horizontal and Vertical duplex piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.

Send your pumping problem to us; our Engineers will recommend the right pump for the job.

Warren 14-in. Single-Stage Double Suction Pump



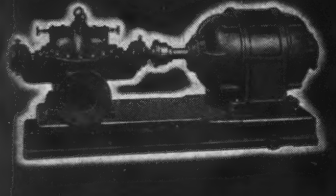
Warren Heavy Liquid Centrifugal Pump

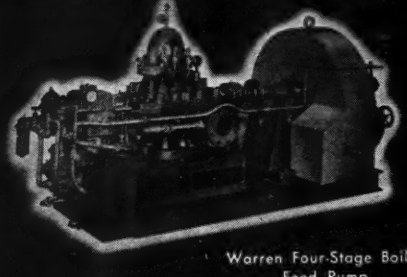
Warren Two-Stage Volute Centrifugal Pump

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

Warren Single-Stage High Speed Centrifugal Pump





Warren Four-Stage Boiler Feed Pump

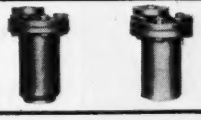
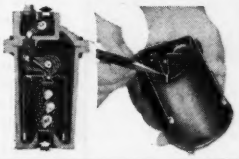
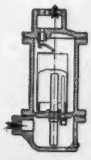
Warren Horizontal "Realwear" Duplex Piston Pump

Some Aids to the Selection of STEAM TRAPS

In planning the installation of steam traps, it is desirable to have in mind the types of traps available for various services. The chart below, describing briefly the Armstrong Traps available to meet practically any condensate requirements, will serve as a guide.

For complete data, capacity charts, prices, selection procedures, etc., send for your copy of the ARMSTRONG STEAM TRAP BOOK.

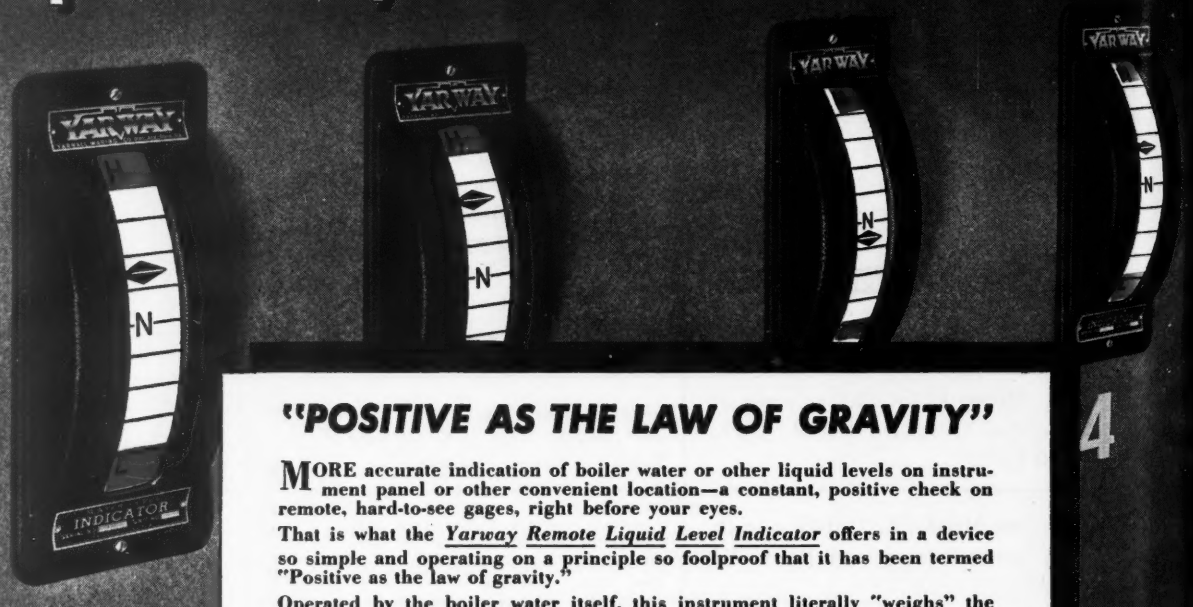
ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

SERVICE	TYPE OF TRAP
1. HIGH PRESSURE or where all steel fittings are desired. (Up to 2400 P.S.I.)	Armstrong Inverted Bucket Steam Trap with FORGED STEEL body and cap. Screwed or flanged connections. 
2. MEDIUM PRESSURE — coils, kettles, headers, etc. (Up to 250 P.S.I.)	Armstrong Inverted Bucket Trap with cast semi-steel body and cap and same stainless steel mechanism used in forged steel traps. Side-inlet side-outlet or bottom-inlet top-outlet connections.
3. LOW PRESSURE—unit heaters, coils, etc. (From 1 P.S.I. up.)	Identically the same traps, except for part sizes, as No. 2 above!
4. WHERE LARGE AMOUNTS OF AIR MUST BE HANDLED —such as on "up-and-down" process units and low pressure heating systems. (Pressures to 250 lbs.)	Armstrong Inverted Bucket BLAST TRAPS capable of handling 500 to 1500 cu. ft. of free air per hour, depending upon bucket size. 
5. WHERE EXCESSIVE AMOUNTS OF CONDENSATE MUST BE HANDLED—steam separators, purifiers, hot water heaters, etc. (Pressures to 900 P.S.I.)	Armstrong PISTON OPERATED Compound Traps with capacities up to 300,000 lbs. of condensate per hour.
6. WHERE PULSATING PRESSURES ARE ENCOUNTERED such as caused by reciprocating engines and pumps. (Pressures to 600 P.S.I.)	Armstrong Inverted Bucket Traps with special separating chambers. 

ARMSTRONG STEAM TRAPS for **POWER PROCESS HEATING**

Over a Million in Use!

NEWS! A Water Level Indicator Operated by the Boiler Water Itself



"POSITIVE AS THE LAW OF GRAVITY"

MORE accurate indication of boiler water or other liquid levels on instrument panel or other convenient location—a constant, positive check on remote, hard-to-see gages, right before your eyes.

That is what the *Yarway Remote Liquid Level Indicator* offers in a device so simple and operating on a principle so foolproof that it has been termed "Positive as the law of gravity."

Operated by the boiler water itself, this instrument literally "weighs" the difference between a constant column of water and the varying level in the boiler drum and indicates this difference, continually, by pointer movement over a calibrated scale.

That's all there is to it.

Extreme accuracy and instant indication are assured because the instrument is frictionless. There are no stuffing boxes. Operates by means of a unique, powerful, permanent magnet transmission between actuating mechanism, under pressure, and indicating mechanism, at atmosphere.

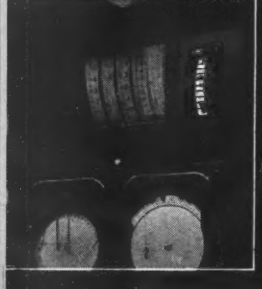
Hundreds of Yarway Remote Liquid Level Indicators in service throughout Industry and the Yarway Steam Laboratory's own accelerated endurance test (duplicating over 50 years of normal boiler service) have proved the dependability of this instrument beyond question.

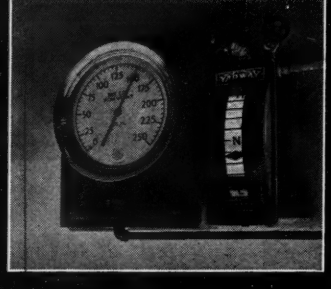
Satisfied that it more than meets exacting Yarway Standards, this instrument is now offerod to the general public. Look into this *moderately priced* instrument which is easily installed on new or existing boilers and is suitable for all pressures up to 1500 lbs.

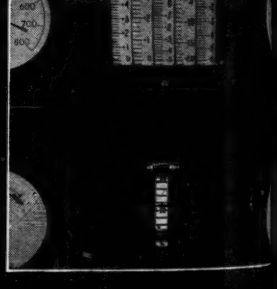
Write for Bulletin WG-1820.

YARNALL-WARING COMPANY, 114 Mermaid Avenue, Philadelphia 18, Pa.

A FEW OF THE HUNDREDS OF YARWAY REMOTE LIQUID LEVEL INDICATORS IN STATIONARY AND MARINE SERVICE







YARWAY REMOTE LIQUID LEVEL INDICATOR

WHAT LEADERS SAY

Reconversion and the Power Industry

By LOUIS KAHN

EVERYONE connected with the power industry faces a level of activity in the reconversion period higher than anything in the past.

Several factors make this so:

1. We know from our organizational contacts with industrialists that many new plants will go up in the immediate postwar perior to supply civilian goods at a price to meet the intense competition indicated in that era. All these plants will require new power facilities and equipment which will have to be manufactured in the postwar period because there is none remaining in the national stockpile.

2. War plants suitable for conversion to civilian goods will require extensive overhauling of their power house equipment, or in some cases complete replacement, in order to get power costs, which are an integral part of the cost of the finished product, down to meet competition.

3. Industrial nations overseas in the combat zones will face the task of almost completely rebuilding their power facilities because the power house is one of the first objectives of enemy bombers. Not only has most of their prewar equipment been completely destroyed, but so have the facilities for building new equipment. Such nations will look to this country, and to a lesser extent to Sweden and Switzerland, for the power equipment to get their industrial machine started again.

4. Any extension of government projects, whether as postwar unemployment cushions or for so-called rural electrification, will increase the production burden on equipment manufacturers.

5. Rapid postwar expansion in household and industrial uses of new and replacement electrical devices and accessories will increase the demand for power, which in turn points to the necessity for greater generating capacity.

6. The facilities supplying power to our prewar industrial plant have not been reconditioned for the past five or six years due to a lack of parts and new equipment. Yet these facilities have operated at capacity on converted war products and are, in many instances, in need of modernization.

Indications are that our power plant equipment manufacturers will have to enlarge their production capacity greatly to meet immediate postwar needs in many directions.

The power industry differs from most others in that there is never any extensive accumulation inventory of new equipment. Each power house is designed to serve the specific plant of which it is an integral part. Equipment is then manufactured to fill those specific needs.

The result is that practically the only available reserve equipment, when war plant construction got under way, was that replaced by new power house installations. Federal officials combed the country to locate this old equipment for war plant heat and process steam. We reconditioned some boilers more than forty years old for installation in some of the nation's largest and most important war plants.

In one huge aviation project we were forced to use three different types of boilers and design the building around the available equipment. That procedure did well enough in war time, when speed of production and not cost is the controlling factor. But cost per unit of output will be dominant in civilian production, and it is obvious what would happen to power costs in a plant serviced by three different types of boilers, with the extra burden of stocking different sets of replacement parts, and other abnormal operating and maintenance costs.

Plants designed to build one war item and converted to a different type of civilian product will almost certainly require some alteration to meet different needs for heat and process steam.

All such wartime installations will have to be studied from the standpoint of getting power costs at a minimum for civilian market competition. Practically all such installations also were made at least partly with equipment not found practical for further industrial use before the war, and the need for complete replacement or extensive reconditioning is obvious.

Equally obvious is the need for a restudy of prewar industrial power installations from the standpoint of low cost unit production. There have been practically no new boilers and power facilities available in the past four or five years, and the pressure on equipment manufacturers will be tremendous.

It will be imperative, therefore, that these manufacturers resume production on their prewar products at the fastest rate which the availability of men and materials will allow. It is likewise imperative that they expand their production capacity. There is little prospect or need for any radical changes or improvements in power equipment in the immediate postwar years for the reason that the pent-up demand will absorb all the equipment that can be built, and for the further reason that these manufacturers, converted to war goods, had little opportunity for research and development in the war period.

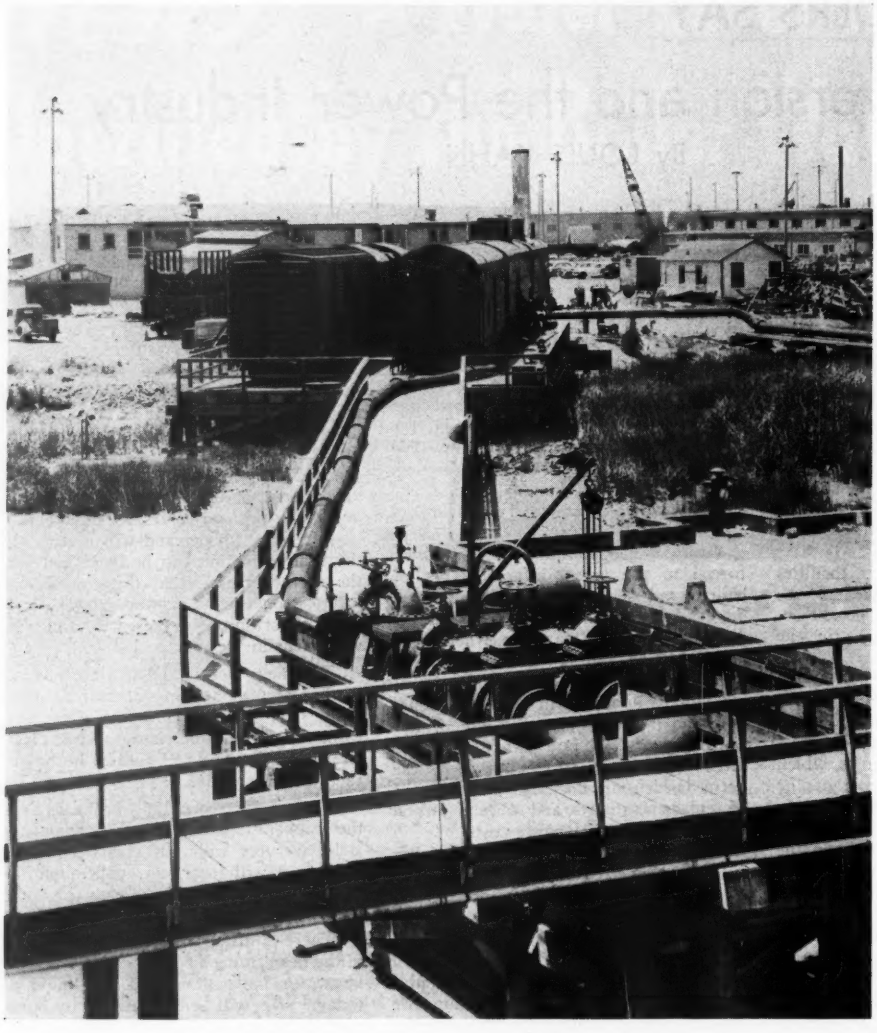
Two new factors are of vital interest to the engineer and manufacturer, however. One is the development of the gas turbine, and the other is the use of electronics for heating and control in manufacturing operations.

Both hold tremendous promise, and the possibilities for electronics, particularly, are very wide. It seems improbable that it will soon find application for space heating, but it is already in wide industrial use for heat treat of metals.

There is little prospect of any change in the near future in the industrial power house, or boiler house, as we know it today. We will still continue to burn coal, oil or gas to make steam for heating and process work. It is quite probable that the gas turbine will be developed for use as a prime mover in central stations in the near future.

But regardless of the long range trend of developments in those fields, the power industry in all its many ramifications faces a postwar market which will be immediate and immense.

Louis Kahn is president of Albert Kahn Associated Architects & Engineers, Inc., headquartered in the New Center Building, Detroit, Mich. This firm is generally regarded as the leading exponent of the basic premise that beauty in design can be combined with industrial utility at no extra cost. Among the notable wartime commissions executed by this firm are the Dodge Chicago Aircraft Engine Plant, largest integrated industrial layout in the world, the Ford Bomber Plant at Willow Run, the Chrysler Tank Arsenal, the Buick Aluminum Foundry and many other General Motors Plants, the Higgins New Orleans Fabricating Plant, the Wright Lockland project, and many others. As long ago as the late 1930's, the firm designed and constructed numerous Naval bases and facilities in the Caribbean and Pacific areas. Despite the extreme pressure upon him, Mr. Kahn has taken time to prepare the above encouraging statement, at our request, exclusively for the readers of POWER PLANT ENGINEERING.



Mobile Plant at Mare Island

This photograph is one of the first published views of one of the two 10,000 kw mobile steam power plants built by General Electric for the Bureau of Yards and Docks, U. S. Navy, in actual use. These units were completed early last year and have been in actual service, furnishing power wherever needed. This is a six-car unit, complete with boiler, generators and condenser and it can be hauled speedily by rail to supply power at any West Coast Naval establishment. This is an official U. S. Navy photograph showing one of these units in use at the Mare Island Navy Yard. In the foreground can be seen the suction strainers, circulating water pumps with motor and hose. This complete assembly of pumps, strainers, etc. can be loaded on a gondola car, ready to set up in a short time. Sectionalized rubber hose carries the water to the condenser in the turbine car. The hose extending to the right from the turbine car carries the circulating water back to the bay. The boiler is oil fired and is equipped with forced draft fans and air heaters. Besides the boiler and turbine car, four other cars make up the complete train. These are, switchgear car, transformer car, a freight car and a gondola car. A tank car, not part of the train proper provides Bunker C fuel oil for the boiler car. The freight car referred to contains a complete workshop for servicing and making minor repairs to equipment. The fuel oil transfer pumps, general service pumps, high tension junction boxes, and other parts needed to place the unit in service are stored in this car in transit.

WITH THE EDITORS

Starting with VE Day

When victory in Europe comes to the Allies, as it most surely will in the not far distant future, a new epoch in history will begin. So terrible has been the loss of human lives, the destruction of industrial works, buildings, bridges, dams, and in fact everything built by man, that civilized people everywhere will not only welcome but demand an opportunity to start a new order of things with the hope of creating conditions under which human beings can peacefully work out their highest possible attainments.

The most trying and difficult problems within this country have to do with the economic status of individuals—jobs for the workers, compensation for services, security of investments or savings, financial security during forced unemployment, sickness or old age, and all other human difficulties that can be solved by the exchange of money.

Economic conditions are almost wholly dependent upon human relations, the treatment of individuals or groups of individuals by other individuals or groups. For every law written to punish recognized infractions of fair dealings there are dozens of courtesies extended among individuals that are not written into laws but have become the codes of conduct or manners that go to make up the personalities of individuals. Human relations, whether they be good or bad, are the result not only of laws but the customs practiced by the people.

Individual freedom, during times of peace, to engage in any legalized business, occupation or profession without monopolistic interference is an inalienable right of every law abiding citizen.

To engage in business, an occupation or a profession a person must of necessity have dealings with other individuals whose rights must also be respected. In this field of opportunity, it is the function of Government to formulate and enforce regulatory laws. Laws that apply to every individual, company or corporation regardless of size. It is the function of management to operate within the prescribed field.

The individual tradesman, professional man, small or large business man must acquaint himself with the laws pertaining to his occupation, not only those forbidding practices considered unfair to society but the rights that cannot legally be taken away. It must be recognized that every restrictive or regulatory law reduces the opportunities of all those engaged in the occupation or business to which it applies, so it is highly desirable to make certain that these laws are essential to the betterment of society in general before they are put into effect.

For peaceful conduct of business affairs, regulatory measures must be in the form of written laws duly enacted by regularly elected legislative bodies.

People need to guard their rights from infringement from any source whatever and this can be done through the machinery of the courts which is made available to every individual in the country, whereas physical violence, so often resorted to in controversies, is always punishable legally. We need clarification of antitrust laws applying to all phases of our economic system.

Society generally has an obligation to provide jobs for everybody who will work.

This is not an obligation that can be placed exclusively upon big industrial or business concerns. Unemployment results from the unwillingness of masses of individuals to use their talents and their surplus capital in such a way as to require the services of others. Idle capital and unemployment go hand in hand in our economic system. Industrial institutions can do much toward providing employment, but individuals can do more for themselves than anybody else toward providing jobs for themselves.

It has long been recognized that a person's economic security depends almost wholly upon his preparation and training for useful service in our social system. In these days when a large percentage of the work in industry is performed by machinery, workmen must learn to depend more and more upon mental ability to solve problems that cannot be done by machinery.

Human relations such as management and sales work, business enterprises, contracting, capital investments, machine design, scientific research, all of the so-called professions, are fields in which logical thinking and careful planning play a major part and they must be used to the fullest to provide jobs in the immediate postwar period.

Business concerns that employ only 15 to 30 people are responsible for more employment in this country than are the large corporations each with their thousands of employes. Men with ability, courage and financial backing, are needed to engage in businesses of their own and of their own selection.

Employers are in honor bound to compensate every full-time worker at a minimum scale of wages that will provide a comfortable standard of living and to establish definite advances for the higher skills and responsibilities.

Companies that do not follow some such policy as this are doomed to failure. It is, of course, expected that the organization of workmen in all departments will produce sufficient output to defray all expenses of the company as well as a reasonable interest on the money invested, but for good employe relations, compensation must be fairly distributed among workers in all branches of employment and investors connected with the company.

Equitable distribution of profits is a responsibility of management that cannot be shirked in any industry whether large or small. When losses occur, it is not more than fair that all connected with the company should bear a share of the burden either through reduction in salary, wage scale, bonus or other means agreeable to the management and the employes. Such arrangements are now in operation in some of the leading industries of the country where company-employe relations are of the best.

Wages, salaries, dividends and other expenses must all come out of the earnings of the company, it is the proportioning of the earnings that makes or breaks employe goodwill.

Stable economy demands the production of goods in quantities amply sufficient to meet the desires of the public.

Stable prices, stable wages, consistent profits, depend upon the steady or regular flow of goods from farms, forests, mines and fisheries through the process industries and factories to consumers.

Violent changes in any of the phases of the production or distribution of goods are destructive of economic balance and should be resorted to only when they promise ultimate benefits.

Careful adjustment of a company's production and distribution is essential to its welfare and that of other nearby or related industries as well. This is a problem in the field of management.

Judicious use of publicity for products or services sold will assist in maintaining employment.

Although the standard of living in the United States is higher than in any other country in the world, the desires of its people extend far beyond their present attainments. They want more comforts in their homes, better lighting and heating, cooling for summer, labor saving appliances for household work; they want the cultural atmosphere brought to the home by music, art work, literature and higher education; they want health building recreation and the time for sports, amusements and travel.

They can secure these things only as their work yields the means necessary for purchasing the things and services that can be bought, and the maintenance of full employment at high-level wage scales will bring about a prosperity that will surprise even the most optimistic, for the American people are hard workers and liberal spenders.

Publicity is a tool which can be effectively used to bring about better public relations, create designs, regulate markets, influence employment and foster the establishment of business concerns, and it should be used widely and consistently to build good will among all factions of industrial America.

V-E Day will usher in a new epoch in history. We have many new materials with which to work, processes and tools need to be developed for their manufacture into useful products, markets need to be created and the public informed regarding possible uses. All along the line opportunities exist for both employer and employe, and we can look for full employment of the men returning from the armed services to help supply the market that has been "fenced in" during the period of the war. Friendly and just employer-employe relationship is the greatest need in the immediate postwar period.

By A. T. Comstock
Lynn River Works
General Electric Company, Lynn, Mass.

Power for G-E

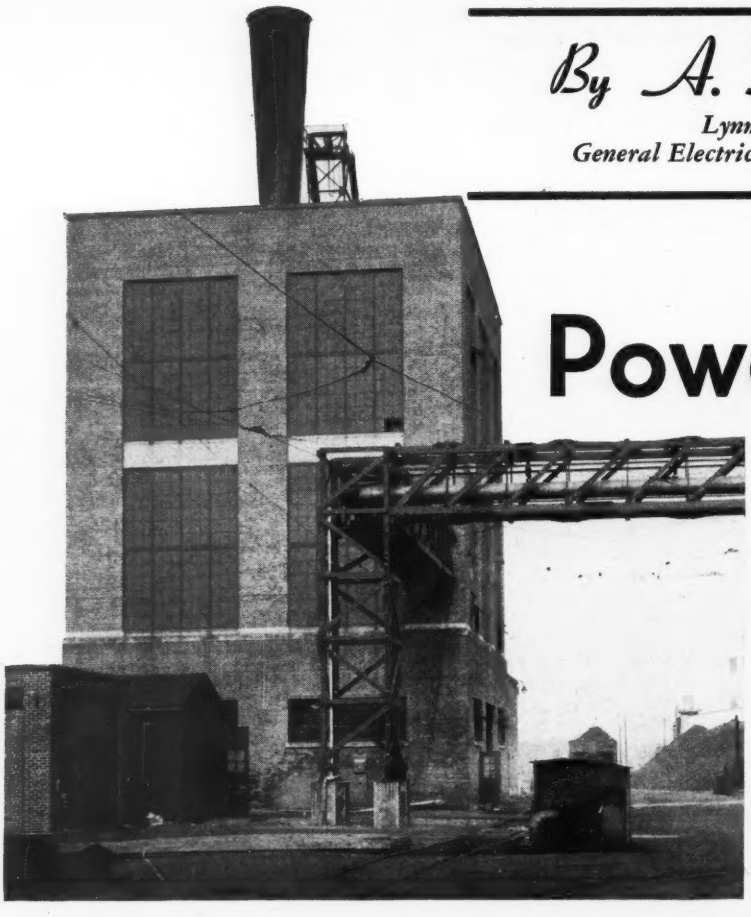


Fig. 1. View of 64—5 Station (see Fig. 3) looking north. In shed, right foreground, is blower for electric power conduit ventilation.

A VARIETY of critical war materials are manufactured at several General Electric Company plants located in Lynn and Everett, Mass. The manufacturing and testing of this equipment results in a heavy demand for electric and steam power, most of which is supplied from a central plant located at General Electric's Lynn River Works.

Back in the early 1930's, during the depression years, the steam plant was largely converted from stoker to oil firing. At that time, the steam plant consisted of ten 600-hp, 200-psi boilers, and two 600-hp, 350-psi boilers. Four of these original units were replaced in 1937 by 1500-psi, 900-F steam-generating units to meet the demands for higher pressure and higher temperature. The higher ratings were required for developmental work of ship propulsion equipment for use by the U. S. Navy and the Maritime Commission. At the same time, additional electric power generating capacity was obtained for the plant by installing a 5000-kw topping turbine generator, 1430-psi at throttle, exhausting to the plant 200-psi, 490-F steam header.

The upward trend of business for actual war production was first felt early in 1939. This, and later events, required rapid expansion of electric and steam power facilities. Two more of the original steam generating units, therefore, were replaced in 1939 by an oil-fired steam unit 200-psi, 120,000 lb per hr

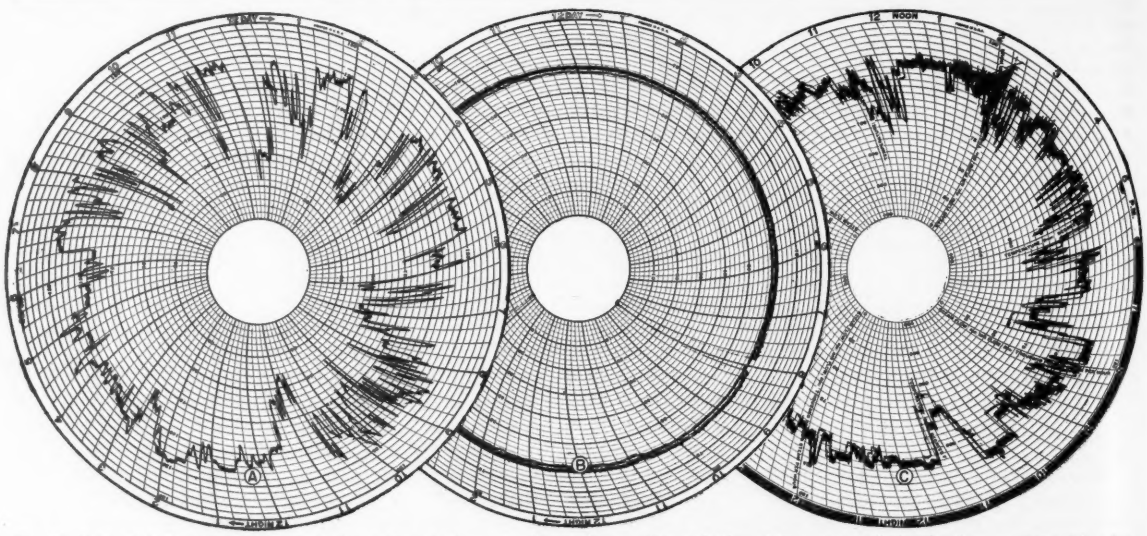


Fig. 2. Typical daily steam flow charts for various boilers. A—Chart from a 200-psi boiler. This unit absorbs load swings on 200-psi header. B—Chart for 1500-psi boilers, which carry base load. C—Chart from a 650-psi boiler supplying testing loads

Rapid increase in war production at General Electric Co.'s River Works, Lynn, Mass., required expansion in steam and power producing facilities . . . Requirements anticipated two years before 1939, when production of war materials started . . . High-pressure, high-temperature steam available when needed . . . Installation of 1500-psi, 900 F steam generating equipment and 5000-kw topping turbine-generator provided 15,000 kw capacity from same boiler room space used for four older units . . . Details of co-ordination of four steam systems at 200, 350, 650 and 1500 psi.

War Production at Lynn

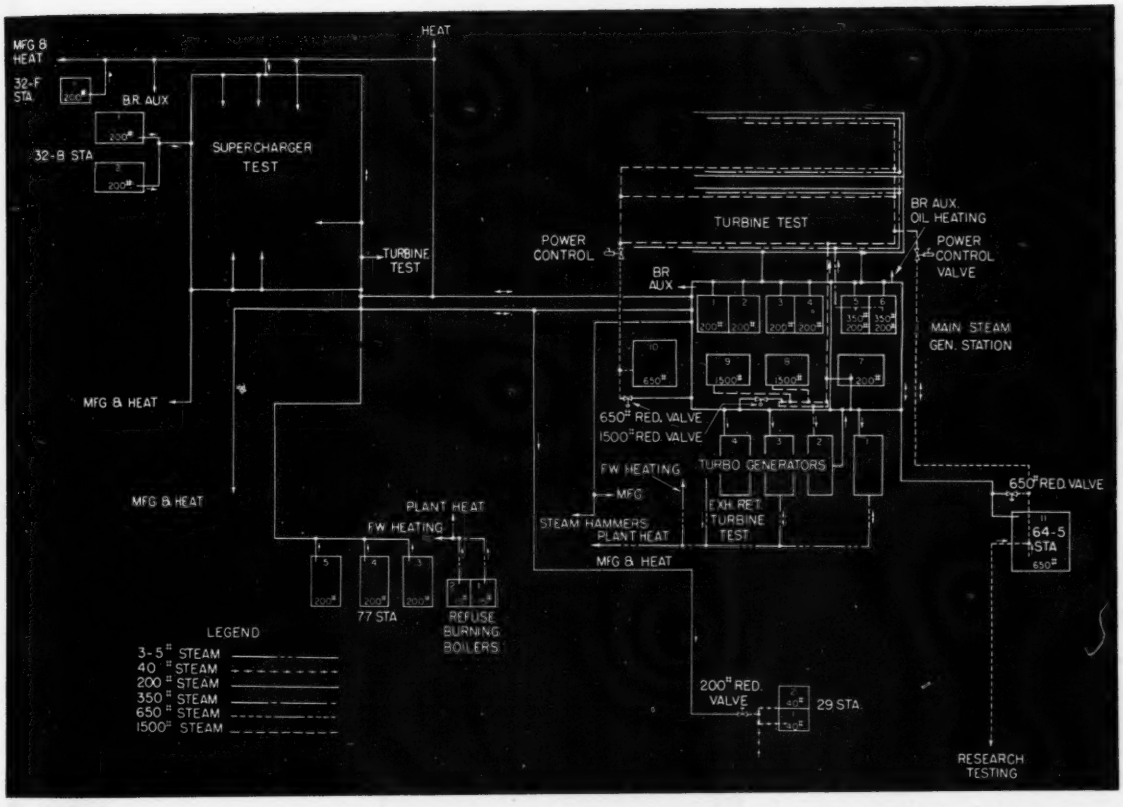


Fig. 3. Diagram of boiler plant locations and inter-connections between steam headers and load centers, River Works central power and steam system

capacity. Thus, in the same boiler-room space, the steam output was almost doubled. Quickly following this, it became necessary to increase the 200-psi steam capacity for testing apparatus for the U. S. Navy and the Maritime Commission. The division producing turbo-superchargers also required additional steam for testing at a load center some distance from the main power plant, previously served by the 200-lb distribution piping.

Expansion of 200-psi Steam Production

Study of the situation revealed that standard type units could be obtained, and three 200-psi boilers, capacity 180,000 lb per hr, were installed at station 77, shown in Fig 3. An addition was placed on this boiler room, already housing refuse burning boilers, for the installation of these three units. This refuse burning station contained two boilers rated 275 hp and fitted with stokers in which sawdust, shavings, hogged refuse wood, and other general rubbish is fired. These units are rated 15-psi maximum pressure and are now used to heat feedwater for three 200-psi units or can be diverted to the plant exhaust heating main at approximately 3 psi. The steam distribution system was reinforced by means of an additional 12-in. main extending from the boiler into the load center.

Steam, used to test equipment in the division producing superchargers, had been supplied from the 200-psi distribution mains. Increasing steam demands could be met only by additional boiler capacity located close to the load. Five months after the plans were started, two oil-fired boiler units were in full operation. These units are rated 60,000 lb per hr, 200-psi. Previously, power for testing in this area had been supplied by a stoker-fired, 22,000 lb per hr, 350-psi boiler. This unit has now been revamped for oil operation and is used to augment the supply actually furnishing feed heating and steam auxiliaries, allowing full output of the new boilers for testing.

Increasing the 650-psi Steam Supply

Further research and testing of Navy equipment, requiring steam up to 650-psi, 850 degrees F, was supplied by an oil-fired integral type boiler. This was installed early in 1940 in an extension of

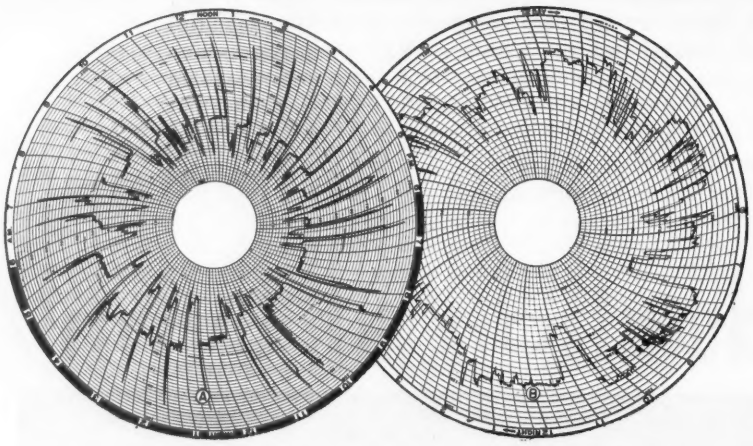


Fig. 4. Typical charts of boiler loads. A—Typical, daily steam flow chart on 200-psi main to turbine test and research areas. B—Typical daily steam flow chart from 650-psi integral boiler supplying test header and reducing station to 200-psi header

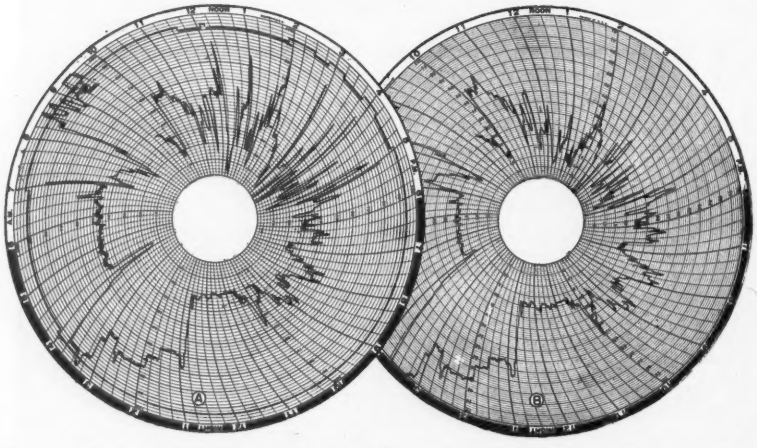


Fig. 5. Charts showing typical daily steam flow to turbo-supercharger test load center. A—For 12-in. parallel main. B—For 10-in. parallel main.

the original boiler room adjacent to the turbine testing area. The boiler has an output of 125,000 lb per hr.

In 1941 the problem of increasing demands and the necessity for reserve, or back-up capacity, was met by installing an additional boiler. Rated 650 psi, 850 F, 150,000 lb per hr, it is the largest unit in the plant. Site for this boiler was selected near the main station at the water front, making it a nucleus of a new boiler station, station 64-5, Fig. 3. Space at this site is available for the extension of the station to accommodate additional boilers and turbine-generators if future conditions warrant them. A possible scarcity of fuel oil and the desire for an additional fuel supply, led to a decision that this new unit should be equipped with a water-cooled stoker, making a variety of high volatile coals available.

Fuel oil for the central plant at the River Works is received by barge direct from nearby refineries. Up to this time, new equipment had been installed for oil-firing with a portion of it constructed so as to be available for pulverized coal if the situation should demand. Final boiler capacity at the central plant totals 120,000 lb per hr at 1500 psi, 900 F; 275,000 lb per hr at 650 psi, 850 F; and 600,000 lb per hr at 200 psi, 490 F.

How Four Steam Pressure Systems Are Connected

There are four steam headers in the plant, as shown on Fig. 3. All 200-psi units, located in three stations, are connected to a general service header. A 650-psi header is extended into two testing and research areas, Fig. 9, one of which is located approximately 800 feet from the station. Both the 125,000-lb-per-hr and the 150,000-lb-per-hr units are connected to this header. These two boiler units are equipped with reducing and desuperheating stations, allowing the operation entirely to test areas or to the 200-lb header, or part flows to either as the load demands require. There is a fourth header, 350-psi from two of the older units, which also extends to the test section. This header has been in existence since 1921.

Also extending to the test and research areas is the 1500-psi, 900-F header, to which is connected the 5000-kw topping turbine-generator. This header also has a desuperheating and reducing station, allowing full or partial flows to the 200-lb header. The 650-lb, 850-F header in the test and research areas is constructed so that steam from the 1500-lb header can also be distributed over this area.

Co-ordinating Steam Generation

The usual plant operation is to carry a base load 24-hr a day, seven days a week on the 1500-psi equipment. The 650-psi units are carried at rated output as continuously as possible, reducing to the 200-lb header any excess not required at rated output. The two outlying 200-psi staitons, with a gross output of 300,000 lb per hr, are adjacent to the load center for turbo-supercharger testing and altitude work for aircraft apparatus. Load requirements here vary from a minimum of 50,000 lb per hr to 300,000

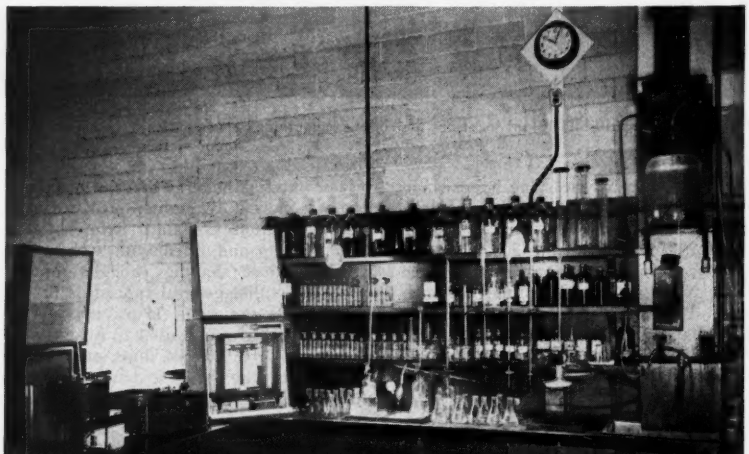


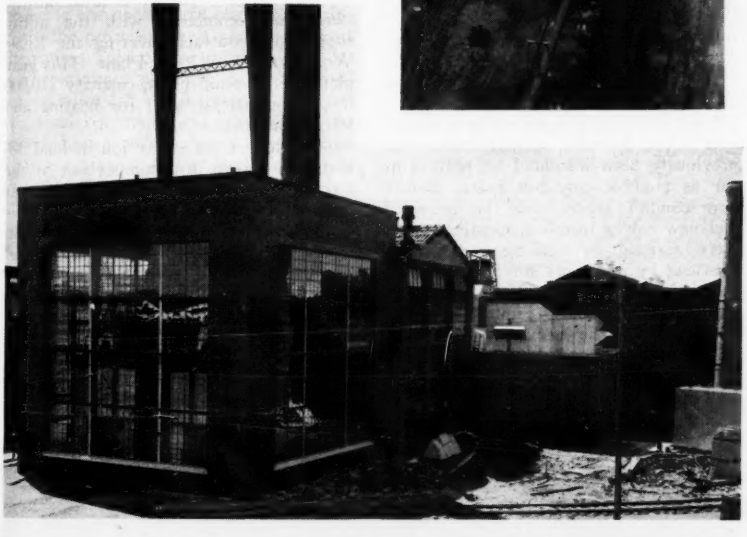
Fig. 6. View in boiler water testing laboratory

lb per hr in addition to a more or less steady manufacturing or process steam load of 50,000 lb per hr. Both these stations carry units on the line to allow war time testing as demands indicate, and the units on the line are carried at a base load so as to absorb heavy fluctuations without delay to testing or production. Steam mains, connecting these two stations with the 200 lb header at the main station, allow the load swings of the system to be absorbed at the main station by the 120,000-lb-per-hr oil-fired, integral-type unit which acts in capacity as the "wheel horse."

Figure 2A gives a typical 24-hour load for this boiler and Fig. 2B illustrates the base steam load carried by the two 1500-psi, 60,000 lb per hr units. Testing loads as taken by the 650-lb

Fig. 7. Right—View of 650-psi steam main running to research test

Fig. 8. Below—General view of Station 32-B and 32-C boiler houses. See also Fig. 3.



boiler with "spill over" to the 200 lb header as test demands fluctuate are shown in Figs. 2C and 4B. Figs. 4A, 5A and 5B showing steam to supercharger testing only, give an idea of the varying load requirements. Interconnections between the steam headers and several boiler locations, together with load centers, are shown diagramatically in Fig. 3.

Each steam line from a header is also metered, including turbine-generators, mains to testing, and manufacturing areas. All steam generating units are metered at output. Condensate from extraction and mixed pressure output is metered, allowing accurate distribution of steam charges to various users.

Solving the Feedwater Problem

Feedwater has presented a distinct problem at the Lynn River Works. While much of the steam, used for turbo and gear testing, is returned to either the heating system or to the mixed pressure turbine-generators, conditions are such in testing superchargers and altitude work that condensate cannot be removed. Overall make-up is in the order of 50 per cent. The two outlying stations carry on with 100 per cent make-up with raw water to units with internal treatment. Condensate from turbine-generators, heating systems, trap returns, and all other sources is automatically diverted to the 1500-lb boilers at the main plant with any excess delivered to the 650-lb units. Raw water make-up in the main station is treated in carbonaceous zeolite softeners and delivered mainly to the 200-lb units. Any lack of condensate for the 1500-lb and the 650-lb units is, at times, made up water from softeners. Final internal treatment is made with phosphate by connections to each individual boiler.

There is an ample supply of salt water from adjacent tide water for cooling purposes. However, all fresh water used for bearing cooling is diverted to a salvage tank and from here pumped under pressure to water softeners for boiler room use. A trained crew is maintained at the boiler room for water conditioning, and a complete laboratory, Fig. 6, is provided. Water conditioning is under the general supervision of a consulting laboratory.

Installed Generating Capacity 31,000 kw

Demands for electric power increased rapidly along with steam requirements. Under pre-war conditions, all power for both the G. E. River Works and West Lynn Plants was generated in the main power station located at the River Works, power for the Everett Plant being supplied by local utility. The generating station consists of the 5000-kw topping turbine-generator previously mentioned, one 10,000-kw, 200-psi condensing unit, and one 6000-kw unit and one 10,000-kw unit, both 200-psi, arranged for condensing, mixed pressure, and extraction operation at approximately 3 lb for feed heating and plant heating. Exhaust steam, available from testing and research sections, can be absorbed in winter by the plant heating

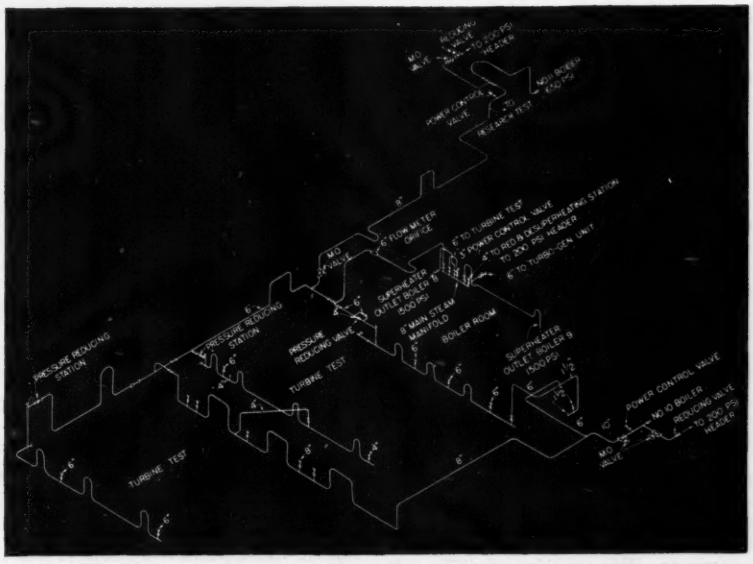


Fig. 9. Perspective view of interconnections of 650-psi and 1500-psi steam header systems and turbine test areas

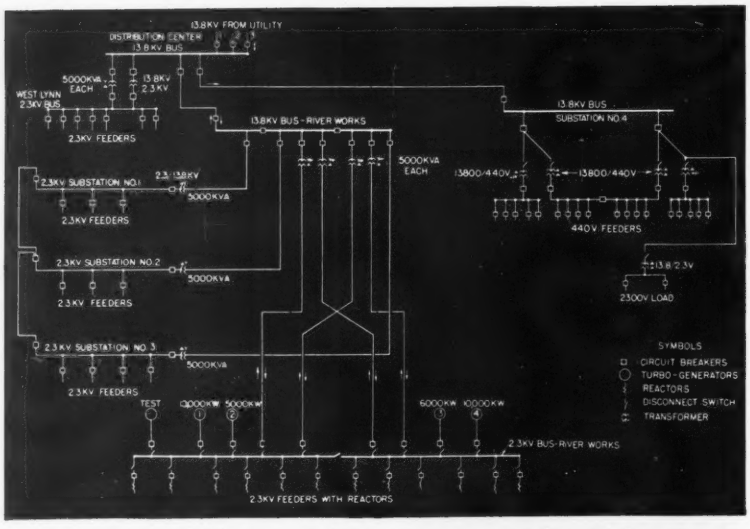


Fig. 10. General one-line diagram of electrical connections with River Works, various substations and utility tie-in

system and in non-heating periods by mixed pressure turbine-generators.

Decision was made not to expand the plant generating capacity during this emergency. Additional power required beyond firm capacity of the generating station is purchased from the local utility. The tie to the utility consists of three cables, 13,800-v, approximately 6000-kva capacity each, terminating at a distribution center located at the West Lynn Plant. From this load center, two cables extend to the main bus at the River Works, each 6000-kva capacity also at 13,800 v. These cables have previously supplied West Lynn Works from the River Works generating station.

Generation at the River Works is at 2300-v and the distribution to plant sections also 2300-v. Increased demands on the distribution system was supplied largely by three 13,800-v feeders with 5000-kva transformers and switchgear located at points farthest from the station and picking up existing and new 2300-v feeders at these substations.

Tying in with the utility system and the installation of 13,800-v plant distribution required a new 13,800-v station bus and switchgear. Four 5000-kva transformers are installed between this new bus and the old 2300-v station bus. This allows parallel operation with the utility when necessary, and bus tie breakers in the 13,800-v bus allows certain feeders to be carried on the utility power without necessity of parallel operation of River Works generators and the utility system.

Tying in with utility system made it necessary to revamp the 2300-v switchgear to match the increased system capacity and the existing feeders from the 2300-v bus were given additional protection by installation of reactors. Figure 10 shows the arrangement.

Main station 2300-v bus has a connection to the turbine-generator testing section making it possible, by means of a transformer station, to synchronize any 60-cycle unit with the main plant generators. This provides possibility of generator tests at less than unity power factor over a wide range as well as considerable fuel conservation.

Distribution of power in the River Works Yard is by means of underground duct lines, some of which pass over steam conduits, which sections had previously been insulated to reduce, as far as possible, any hot spots. Before new conduit space could be provided and new cables installed, existing cables were assisted in taking considerable overload by means of forced ventilation in the duct lines. A total of six blowers handling about 30,000 cfm of air were installed at the proper locations on the duct line. Figures 1 and 11 show two different views of a typical blower installation. With some care used to block off open ducts and with some baffling, this arrangement exceeded all expectations as it was possible to force air easily to all ends and sections of the duct lines in necessary amounts to dissipate any extra heat and to reduce temperatures to safe amounts. While there are no overloaded cables at the present time, this ventilating scheme will be continued for the duration as an added insurance, on the theory that cable life is a product of heat and time, and useful life will be extended by the lower operating temperatures resulting from the ventilation.

Under supervision of the River Works organization, additional manufacturing plants under D.P.C. control have been constructed at both Everett and Lynn. A windowless, completely air conditioned plant for the manufacture of turbo-superchargers, located at Everett, Mass., has a steam power plant, capacity 180,000 lb per hr, 200-psi, used for heating and for testing purposes. Power for manufacturing operations is supplied by the local utility. A gear plant, located at Lynn adjacent to the River Works, is supplied power from the local utility, same being combined with the utility supply and contract covering the River Works and West Lynn Plant. This gear plant has a steam plant, capacity 210,000 lb per hr, 200 psi, used for heating and testing purposes.

An idea of the expansion in load demands is shown in a comparison of the power plant outputs and electric power consumption. In 1940, the River Works group power plant produced total steam to about 1,500,000,000 lb "from and at." The steam output from this group for 1943 was approximately 5,000,000,000 lb. Electric power usage for 1940 was approximately 60,000,000 kw-hr generated and 7,000,000 kw-hr purchased. The corresponding figures for the group for 1943 are 104,000,000 kw-hr generated and 92,000,000 kw-hr purchased.

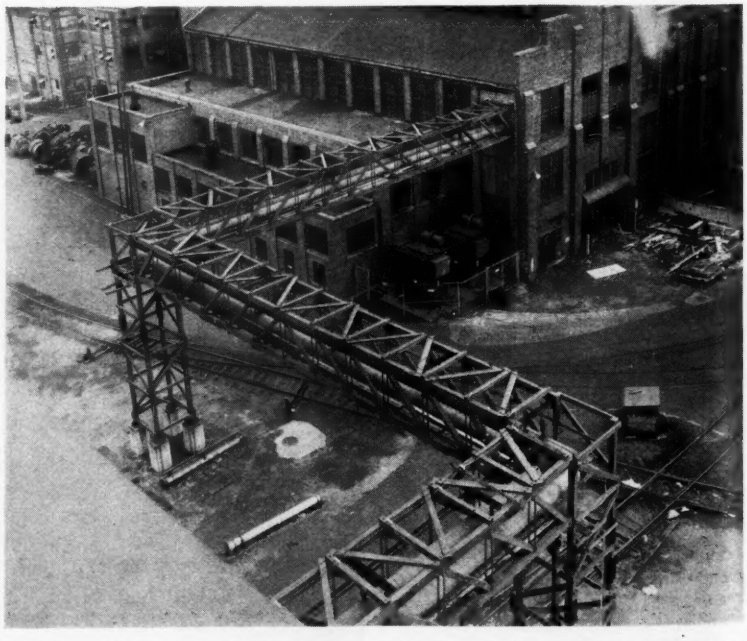


Fig. 11. Trestle from 64—5 Station to main steam generating plant carrying 650-psi—200-psi steam, 100-psi air and gas. On ground near track intersection, is same blower installation for electric conduit ventilation as shown in Fig. 1.

Kentucky Dam Project of TVA

Part II

Detailed discussion of auxiliaries and services for four 44,000-hp Kaplan hydraulic turbines, driving 35,000-kva generators at Kentucky Dam power house . . . Complete details of generating units and governors were given in Part I, in the January issue . . . This part describes: oil systems for turbine runner hubs, governors, switchyard; compressed air systems for general service, draft tube evacuation, generator brakes, spillway bubbler; treated water, fire protection and cooling water systems; drainage, watering, and heating.

By C. L. NORRIS and R. M. GARDNER *Senior Mechanical Engineers*

Design Department Tennessee Valley Authority Knoxville, Tenn.

THREE SEPARATE OIL systems are provided to handle and transport the oils of different characteristics contained in the switchyard electrical equipment, the governors and generators, and the runner hubs of the turbines.

The storage, purification, and pumping facilities for the insulating oil in the electrical equipment are located in the power house service bay. The storage facilities consist of four steel tanks, each of 6450-gal capacity. Two tanks are for dirty transformer oil, one for dirty circuit breaker oil, and one for clean oil. A 100-gpm motor-driven, gear-type pump is provided to transport clean oil from the plant to the switchyard. Oil drains by gravity from the switchyard to the storage and purification room.

The oil purifier has a capacity of 600-gph when purifying oil without the use of the filter press and 900-gph capacity with the aid of the filter press. The purifier is an integral unit complete with centrifuge, inlet and outlet pumps, filter press, filter paper drier, electric heaters and control and metering accessories. A complete piping system is provided to carry the oil in the electrical equipment to and from the purification plant. All connections between the electrical equipment and the piping system are made with flexible hose.

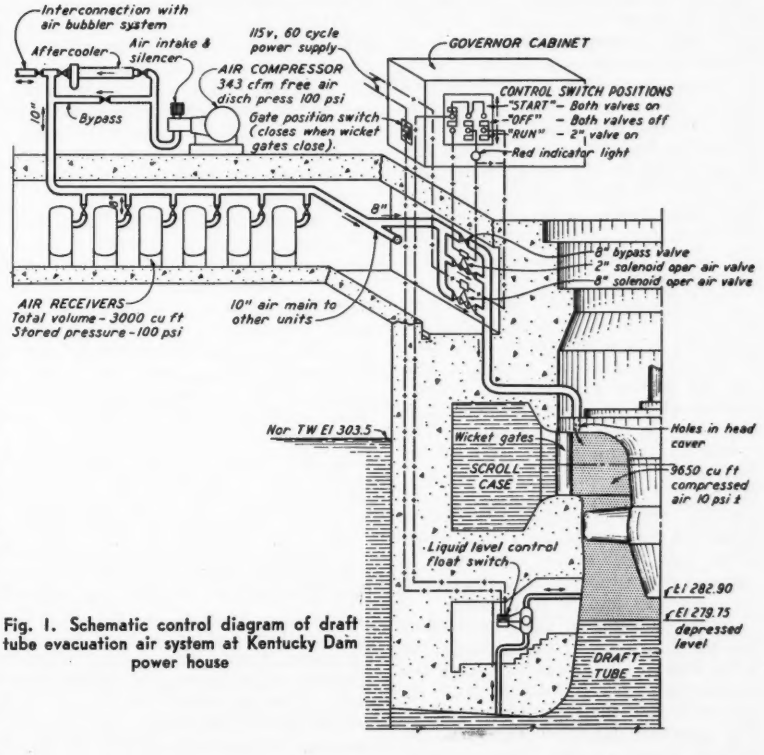

Interconnection with air bubbler system
Aftercooler
Air intake & silencer
115v, 60 cycle power supply
GOVERNOR CABINET
AIR COMPRESSOR 343 cfm free air disch press 100 psi
CONTROL SWITCH POSITIONS
"START" – Both valves on
"OFF" – Both valves off
"RUN" – 2" valve on
Red indicator light
10"
Bypass
Gate position switch (closes when wicket gates close).
8"
8" bypass valve
2" solenoid oper air valve
8" solenoid oper air valve
AIR RECEIVERS Total volume – 3000 cu ft Stored pressure – 100 psi
10" air main to other units
Nor TW El 303.5
Wicket gates
Holes in head cover
SCROLL CASE
9650 cu ft compressed air 10 psi g
Liquid level control float switch
El 282.90
El 279.75 depressed level
DRAFT TUBE

Fig. 1. Schematic control diagram of draft tube evacuation air system at Kentucky Dam power house

Oil System for Power Units

There are approximately 5000-gal of oil in each of the main power units. This oil is in the two generator bearings for lubricating purposes and in the governor as an operating medium for the hydraulic system. The oil in this system is purified in batches rather than by recirculation. The oil storage facilities consist of one dirty and one clean oil tank, each of 5100-gal capacity. Two motor-driven, positive-displacement, 30-gpm pumps, one for each oil and one for dirty oil, are provided for transporting purposes. The oil purifier is a self-contained stationary type having a capacity of 350-gph and is complete with centrifuge, pumps, electric heaters, control equipment, and meter. A complete piping system is installed between the main units and the purification facilities.

Each turbine runner contains approximately 1600-gal of heavy viscous oil for lubricating the moving parts within the hub. During inspection or dismantling of a unit, it is necessary to remove this oil from the hub. A permanent pipe header is installed in the draft tube access gallery with branch headers terminating at the draft tube access door of each unit. Two portable oil storage tanks and an 8-gpm motor-driven screw pump are provided to handle the oil. The tanks, pump, and hub are connected to the permanent pipe header with hose, and the oil is pumped to and from the hub.

Because of the infrequency of performing the above operation, the two storage tanks and the pump were made portable so that they may be transferred to any one of the Authority's power plants having Kaplan turbines.

The following air systems are provided at this project for operation of various pieces of equipment and for general service. A portable, air-cooled, motor-driven air compressor, having a capacity of 82 cfm of free air, operating at a discharge pressure of 100 psi, is provided for general service, wherever required. A 100-psi system is provided at the lock for tool service and operation of the navigation signal horn. This system is supplied by a stationary 60-cfm, 2-stage, air-cooled, motor-driven compressor which, together with a 45-cu ft air receiver, is located in the lock operations building.

The power house station air system, operating at 100 psi, consists of a 113-cfm, stationary, single-stage, double-acting, motor-driven compressor, a 150-cu ft air receiver, and a complete piping system to distribute the air to various service outlets located throughout the

power house, to the intake and draft tube decks, and to the generator brakes. The system includes a water-cooled aftercooler and control equipment for automatic operation of the compressor.

Draft Tube Evacuation Air System

The draft tube evacuation air system is provided to depress the tailwater in any one of the main unit draft tubes below the bottom of the turbine runner when it is desired to motor the unit. This is done to save power when a unit is operating as a synchronous condenser to regulate voltage and correct power factor. This system is shown in Fig. 1.

Compressed air for the system is supplied by a stationary, single-stage, double-acting, motor-driven compressor having a capacity of 343-cfm of free air, operating at a discharge pressure of 100 psi. Six air receivers located in the basement of the service bay provide 3000 cu ft of air storage for the system. A complete piping system carries the air from the storage receivers to the head covers of the turbines. Two solenoid-operated control valves, one 8-in. and one 2-in. size, arranged in parallel, are located adjacent to the unit in the air supply line to each head cover. A cage-type float-control switch is attached to each draft tube liner adjacent to the draft tube access door. A rotary-type switch for control of the system is mounted on the governor panel.

With the unit on load, when the control room operator wishes to operate the generator as a synchronous condenser, he signals the governor attendant, who sets the control switch to the "Start" position which energizes the solenoids of both the 8-in. and 2-in. air valves. The switchboard operator then backs off his load, and when the wicket gates have reached the fully closed position, the electrical circuit is completed through a contact on the gate-position switch, which allows both the 8-in. and 2-in. solenoid-operated valves to open fully and release compressed air into the draft tube.

When sufficient air has been released into the draft tube, to a point where the water level has been depressed below the turbine runner blades, the float switch on the draft tube shuts off the air valves. The governor attendant then sets the control switch to the "Run" position which permits only the 2-in. valve to operate under the regulation of the float control to compensate for any leakage loss from the draft tube and to maintain the depressed level below the blades. The red signal light on the governor cabinet appears each time the air valves open, to signal the operator that air is being admitted to the draft tube.

To restore the unit to normal operation as a generator, it is only necessary to open the wicket gates and set the control switch to the "Off" position which will shut off the air supply. The air will be forced out of the draft tube to the tailrace as the wicket gates open and the headwater enters.

With tailwater at normal elevation, air pressure in the draft tube is approximately 10 psi, with 9650 cu ft of water being displaced. The usual time required to motor a unit with compressed air is approximately one minute, with the kilowatt input to the generator ranging from 600 to 800, depending upon the blade tilt of the runners. Motoring without the injection of compressed air requires in the neighborhood of 3500 to 5000-kw, again depending upon the position of the runner blades.

Spillway Bubbler for Ice Prevention

A separate compressed-air system, known as the Spillway Bubbler air system, was installed to prevent the formation of ice on the spillway gates during periods of severe winter weather. Design investigations indicated that 12 of the 24 gates might be required to operate to maintain the necessary control of the reservoir during these periods.

The system is supplied by one stationary, single-stage, double-acting, motor-driven compressor having a capacity of 343-cfm of free air, operating at pressure of 100 psi. This compressor is a duplicate of the draft tube evacuation air compressor previously mentioned, and the two systems are inter-connected to provide stand-by capacity for each other. The compressor and a 500 cu ft air receiver are located in the power house service bay.

A complete piping system carries the air from the receiver through a pressure-reducing station to 24 valved outlets located in boxes on the spillway deck. Each box contains a throttling needle valve, a strainer, a pressure gage and two ½-in. hose connections. When freezing weather occurs, either one or two lengths of ½-in. armored hose are attached to the connections in the box at each gate bay to be kept ice-free. The other end of the hose is submerged in about 10 ft of water on the reservoir side of the gate. The submerged end of the hose is fitted with an orifice nozzle.

Experiments conducted in connection with a similar system at Grand Coulee Dam indicated that reservoir water temperatures at depths of more than 8 ft were relatively constant and that surface ice produced very little change in temperature. Compressed air discharging under water is utilized to produce an upward flow of the warm water to prevent the formation of surface ice. Experiments were also made using compressed air discharging through orifies, the final results of which indicated that a sharp-edged orifice of ⅛-in. diameter and a tube length of three diameters gave the best bubble pattern to induce the required upward mixing flow.

The main-line pressure on this system is carried at 25 psi, and the pressure supplied to the orifice is throttled to approximately 6 lb by the needle valve. It is assumed that one length of hose per forty foot gate bay will be sufficient for short periods of freezing weather and that two lengths may be required for long periods of more severe weather.

Treated water is used for all sanitary services in both the lock and power house. Water from this system is also used for fire protection and general service throughout the power house and switchyard. Water is obtained from the reservoir, with a raw-water pump and intake being located in the lock. The filter plant which was installed during the initial stages of dam construction is located on the right bank of the river near the lock. The plant which has a nominal capacity of 62-gpm is a conventional type consisting of a rapid sand gravity filter, mixing chamber, sedimentation basin, lime and alum dry chemical feeders, chlorinator, service pump and clear well. Elevated storage is provided by a 100,000-gal raw-water tank and a 50,000-gal treated-water tank.

Raw reservoir water is used in the lock for fire protection and flushing the decks. This water is supplied by a 125gpm motor-driven centrifugal pump located in the basement of the lock operations building. The pump draws water through an intake line from the reservoir and discharges through a piping distribution system to various 2-in. hose outlets located in recesses in the decks of both the land and river walls.

Cooling Water Systems

Raw water is also provided in the power house to supply cooling water to the main generators, air compressors, gasoline-engine-driven generator, air-conditioning equipment, and lubricating water to the turbine guide bearings. Each main unit has an intake in its scroll case from which the water is drawn through a multiple-basket strainer and pumped to the generator air coolers and the main guide and thrust bearing coils. The individual pumps are motor-driven, horizontal centrifugal units, each having a capacity of 1200-gpm. Water from the generator air coolers and bearings is discharged back into the scroll case. Water for turbine bearing lubrication normally flows by gravity from the same scroll case intake but may be supplied by the pump if necessary. A water supply is also provided for the water jet eductor which is installed in each unit for wheel pit unwatering.

An emergency cooling-water pump of 1200-gpm capacity is installed in the service bay as a stand-by supply for any one of the individual unit systems which are interconnected.

Cooling water for the aircompressors and aftercoolers, the gas-electric generator set, and the air conditioning equipment condenser is supplied by gravity from the forebay through the intake and strainer for the emergency cooling-water pump. The raw-water systems for the turbines, generators, and gas-electric generator set have their own series of alarm circuits operated by flow-meters and sight-flow indicators to indicate low flows. The gas-electric generator set has its own raw-water pump mounted on the engine.

Drainage and Underwatering Systems

Drainage and leakage in the lock walls are carried either to headwater or to the tailrace through a system of gravity drain lines. The drainage and inspection gallery located in the river

wall of the lock may be unwatered by two 10-in. water jet eductors.

All power house roof, deck, and floor drainage above maximum tailwater is discharged either into the tailrace or into the forebay through a system of gravity drain lines. Floor drainage, seepage, and cooling water discharges from equipment in the service bay, below elevation 360 but above normal tailwater, are collected into a drainage system which discharges to the tailrace under normal conditions and is bypassed to the station sump during conditions of high tailwater. The station drainage sump has a capacity of 15,800-gal and is serviced by two float-controlled, deep-well, turbine-type, motor-driven pumps, each having a capacity of 300 gpm. These pumps discharge directly to the tailrace.

Drainage from the spillway and intake gallery is normally carried to the station sump through a drain line which has a pressure equalizing outlet to the tailrace. A second equalization line from the gallery is provided in the west abutment wall of the spillway. If an excess amount of leakage accumulates in the gallery during periods of high water, the equalization lines will automatically open, thereby permitting the gallery to fill up the tailwater level, which will prevent an excessive internal pressure or uplift on the structures.

Draft Tube and Scroll Case Unwatering

An unwatering system for all draft tubes and scroll cases is provided to permit inspection and repair of the turbine runners which are below the normal tailwater elevation. Two 5000-gpm, deep-well, turbine-type pumps are provided in the station drainage sump to handle the unwatering operation. Each pump is operated by a manually controlled 125-hp vertical motor mounted on the floor over the sump. Either of these pumps may be used to augment the station drainage system pumping capacity. Each scroll case is provided with a screened outlet and a 16-in. drain line with shut-off valve.

When the head gates are closed, the water in a scroll case comes to tailwater level through the wicket gates and through the 16-in. drain line which empties into the draft tube. Each draft tube has a screened outlet approximately 2 ft above the low point. A 16-in. pipe, with control valve, connects the screened outlet of each unit to a 20-in. header which discharges through its own control valve to the suction line of the two unwatering pumps. Water is discharged from these pumps directly to the tailrace.

Machine Shop

The permanent machine shop is located adjacent to the erection area on the generator floor level in the power house service bay. All machinery is of the heavy-duty type, as would be required for work on power house equipment. The floor area of the shop is approximately 1700 sq ft. All machinery is motor driven with motor-starting devices being located on the machines or conveniently nearby. The principal machines and equipment are listed as follows:

1—20-in. engine lathe
1—10-in. bench lathe
1—24-in. shaper
1—30-in. upright drill
1—15-in. sensitive drill
1—9- by 9-in. power hacksaw
1—12-in. grinder
1—Portable pipe-threading machine

In addition to the above equipment, the shop is equipped with a tool post grinder, portable forge and blacksmith accessories, and a full complement of small tools.

Fig. 2. General view of upstream face of Kentucky Dam

Passenger Elevator

An automatically operated passenger elevator is installed in the power house service bay serving six landings with a total lift of 81 ft. It has a rated live-load capacity of 2500 lb at a speed of 300 fpm. The machine is equipped with a 23-hp motor generator and exciter set, 250-v direct-current variable voltage control equipment, a 25-hp hoist motor, selective-collective push-button control, automatic leveling devices and door operators, and all safety devices necessary to conform to the American Standard Safety Code for Elevators.

Emergency Auxiliary Power

A gasoline-engine-driven generator set is provided to operate, in an emergency, all essential auxiliaries such as the spillway gates, unwatering and drainage pumps, and lighting. This unit is located in the power house service bay in a separate room which includes a built-in automatic carbon-dioxide fire-extinguishing system. The unit consists of an 8-cylinder water-cooled gasoline engine rated at 565 bhp at 1200 rpm, direct-connected to a generator rated at 400 kva, 0.8 power factor, 1200 rpm, 3 phase, 60 cycles, 480 v. The unit is complete with cooling-water pump, water-cooled exhaust, oil cooler, direct-connected exciter, muffler and all control equipment, including automatic shut-down devices. Gasoline storage is provided by a 3200-gal tank buried in the earth embankment on the downstream side of the service bay. The storage tank, which is filled by gravity from tank trucks, is equipped with a remote reading level gage located in the engine room.

Heating Systems

The lock operations building is electrically heated by a combination of thermostatically controlled recessed gravity convection and fan-unit-type heaters. The control room, office, and toilet rooms are maintained at 72 F, while other parts of the building are heated only as required for the relief of dampness and excessive chill. The total connected heating load for this building is approximately 90 kw.

The power house is also electrically heated, with spaces subject to continuous occupancy maintained at 72 F and other spaces heated partially. The heating of the control building is integral with the air-conditioning system. Heat losses from electrical equipment in certain areas will be sufficient for normal heating, while all other parts of the power house are supplied with local gravity or forced convection-type heaters. The total connected heating load for the power house and control building is approximately 680 kw.

Ventilation

The lock operations building is ventilated by natural convection except for the basement and toilet rooms, which are mechanically ventilated by exhaust fans. Fresh air is admitted to the basement through areaways and to the toilet rooms through transoms and windows. The air exhausted from this building is approximately 20,000 cfm.

Ventilation is provided in the power house spaces in accordance with the need for human comfort, for dissipation of heat from equipment and solar radiation on roofs, decks, and walls, and for the relief of dampness in tunnels and lower galleries. In the ultimate 5-unit installation, approximately 300,000 cfm of fresh, outside air will be supplied by fans to the generator room, erection bay, and lower parts of the service bay, with the air being exhausted

(Continued on page 86)

MODERN EXTRACTION TURBINES*

Part III. Estimating the Performance of Single-Automatic Extraction Non-condensing Steam Turbines

By L. E. NEWMAN

Turbine Division, General Electric Company
Schenectady, N. Y.

We think we're going to throw away our steam charts and steam tables. Instead of spending the morning crawling around on a steam chart, we find, with these new estimating methods of Mr. Newman's, that, much to our astonishment, we are looking at a performance chart of our own doing before we have really begun to do any heavy thinking.

Try it yourself—we're sure you'll agree that 15 minutes is ample to estimate the performance of even so forbidding a creature as a non-condensing automatic extraction steam turbine.

RARE INDEED is the non-condensing extraction turbine that duplicates any previous design. It is a highly specialized type of turbine design that must be fitted carefully into the power generation plan. Seldom is it found to be the sole source of power for it can make power, without wasting steam, only in response to a demand for steam. It may be built as a non-condensing double-automatic or single-automatic extraction unit, and, despite its special nature, is outnumbered by condensing automatic extraction turbines only about three to one.

The field of application for non-condensing extraction turbines is usually limited to industries having a sustained demand for large quantities of steam at one or more pressures. In such applications the non-condensing extraction turbine maintains constant pressure in the steam process lines, and generates power as a by-product of the steam. Power so obtained is generated at a thermal efficiency in the order of 90 per cent.

Because of the fact that non-condensing extraction turbines make power only in response to a demand for steam, they must be applied with great care. *Condensing* extraction turbines, if designed for greater extraction demands than are found actually to exist, will still deliver their rated output. They do this by making up deficits for power with their condensing sections. Not so the *non-condensing* extraction turbine. If the demand for steam falls short of the need for power, the deficit must be made up by another source of power, or excess steam must be blown to atmosphere. Blowing steam to atmosphere is a way of getting more power by artificially increasing the steam demand. But this is a wasteful means that should be avoided in all but unusual or emergency cases.

The fact that the application of this type of turbine means fitting it exactly to a particular set of conditions requires that it be tailor-made to a greater extent

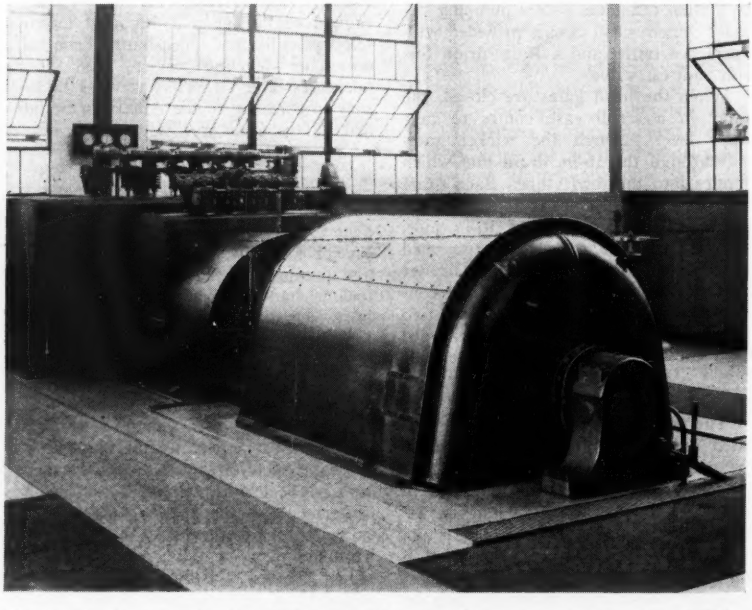


Fig. 1. G. E. non-condensing single automatic extraction steam generator set, 4000-kw capacity, of type and rating analyzed in problem

* All re-publication rights reserved by author.

STEP-BY-STEP METHOD

for determining performance of single-automatic extraction non-condensing steam turbines driving 50 or 60 cycle generators.

CALCULATIONS

TSR_1 $=14.7$ lb/kwhr = Theoretical Steam Rate, from throttle to exhaust (Table 1)
TSR_2 $=33.6$ lb/kwhr = Theoretical Steam Rate, from throttle to extraction (Table 1)
Efficiency $= 0.705$ (Table 2)

A = Full-load non-extraction throttle flow ..... $= \dfrac{TSR_1 \times \text{Rated Output}}{\text{Efficiency}}$

$= \dfrac{14.7 \times 4000}{0.705} = 83{,}400$ lb/hr

B = Half-load non-extraction throttle flow ..... = A × half-load flow factor (Table 3)
$= 83{,}400 \times 0.625 = 52{,}100$ lb/hr

$\dfrac{TSR_1}{TSR_2} = \dfrac{14.7}{33.6}$ ..... $= 0.437$

E = Extraction factor ..... $= 0.60$ (Chart 2)
F = Max. required extraction flow..... $= 140{,}000$ lb/hr
C = Full-load throttle flow at max. required extraction flow
$= A + (E \times F) = 83{,}400 + (0.60 \times 140{,}000)$..... $= 167{,}400$ lb/hr
S = Min. flow to exhaust = *5700, or nearest 500 lb*..... $= 5{,}500$ lb/hr (Chart 3)
M = Max. permissible throttle flow..... $= 250{,}000$ lb/hr (Chart 4)

HOW TO DRAW PERFORMANCE CHART

Plot points A, B, and C, and draw straight lines indicated by Chart 1 ***(the example is plotted on Chart 5)***.

Add the limits:

The min. flow to exhaust limit is a straight line passing through the point on each line of constant extraction flow where the throttle flow is equal to the extraction flow plus the minimum exhaust flow (S).

The max. flow to exhaust limit is a straight line passing through the point on each line of constant extraction flow where the throttle flow is equal to the extraction flow plus the full-load non-extraction throttle flow (A).

The max. throttle flow limit may be chosen at any value not in excess of the max. permissible throttle flow (M), nor in excess of a flow equal to three times the full-load non-extraction flow (3 × A). It is usually taken as approximately equal to the full-load throttle flow at max. required extraction (C).

than condensing types of turbines. This, coupled with the fact that these turbines are designed for initial steam pressures from 150 psi to over 1000 psi, for exhaust and extraction pressures ranging from zero to over 400 psi, and for a wide range of steam flows, introduces a greater possibility of error in estimating their performance than might be expected for condensing types of turbines.

In the February issue of POWER PLANT ENGINEERING a short-cut method was given for estimating the performance of condensing extraction turbines. A companion method is given in this article for estimating performance of non-condensing single-automatic extraction steam turbines. This method permits quick estimates to be made for 50 or 60 cycle steam turbine generating sets rated 500 kw to 7500 kw inclusive. The throttle-flow versus output chart for such a turbine may be obtained by estimating only three points, and then adding limits to the chart. With a little practice, the performance chart for any turbine within the range of this method can be prepared in 15 minutes or less.

Example Problem

The STEP-BY-STEP METHOD with Chart 1 includes all of the instructions needed to prepare preliminary performance charts. In order to make the use of this method clear a performance chart will be estimated for a typical unit rated:—

4000 kw—0.80 pf—5000 kva—60 cycle —noncondensing, single-automatic extraction steam turbine-generator set, for steam conditions:
Main pressure.....400 lb/sq in. G
Initial temperature.....700 F
Exhaust pressure....20 lb/sq in. G
Extraction pressure.150 lb/sq in. G
Max. extraction flow..100,000 lb/hr

All the calculations needed to prepare the performance chart for this turbine are shown in italics on the STEP-BY-STEP METHOD. It will be of interest to follow this through.

Table 1. Condensed Table of Theoretical Steam Rates*

Main Pressure, in lb./sq. in. G..	150	200	250	300	400	600	850
Initial Temperature, in deg. F.	450	500	550	600	700	750	825
Initial Superheat, in deg. F....	(84)	(112)	(144)	(178)	(252)	(261)	(298)
EXHAUST PRESSURE		THEORETICAL STEAM RATES, IN LB./KW.HR.					
0 lb./sq. in. G.....	18.2	16.1	14.6	13.4	11.7	10.4	9.31
5 lb./sq. in. G.....	20.3	17.7	15.9	14.5	12.5	11.1	9.83
10 lb./sq. in. G.....	22.4	19.3	17.2	15.6	13.3	11.6	10.30
20 lb./sq. in. G.....	26.7	22.3	19.5	17.5	14.7	12.7	11.10
30 lb./sq. in. G.....	31.3	25.4	21.9	19.4	16.0	13.6	11.80
40 lb./sq. in. G.....	36.4	28.7	24.3	21.2	17.2	14.5	12.50
50 lb./sq. in. G.....	42.4	32.3	26.8	23.1	18.5	15.4	13.10
100 lb./sq. in. G.....	...	58.1	42.5	34.1	25.1	19.4	15.90
150 lb./sq. in. G.....	...	...	...	51.1	33.6	23.8	18.60
200 lb./sq. in. G.....	...	...	...	...	45.8	29.0	21.50
250 lb./sq. in. G.....	...	...	...	...	...	35.3	24.80

* From "Theoretical Steam Rate Tables" by J. H. Keenan and F. G. Keyes, published in 1938 by A.S.M.E

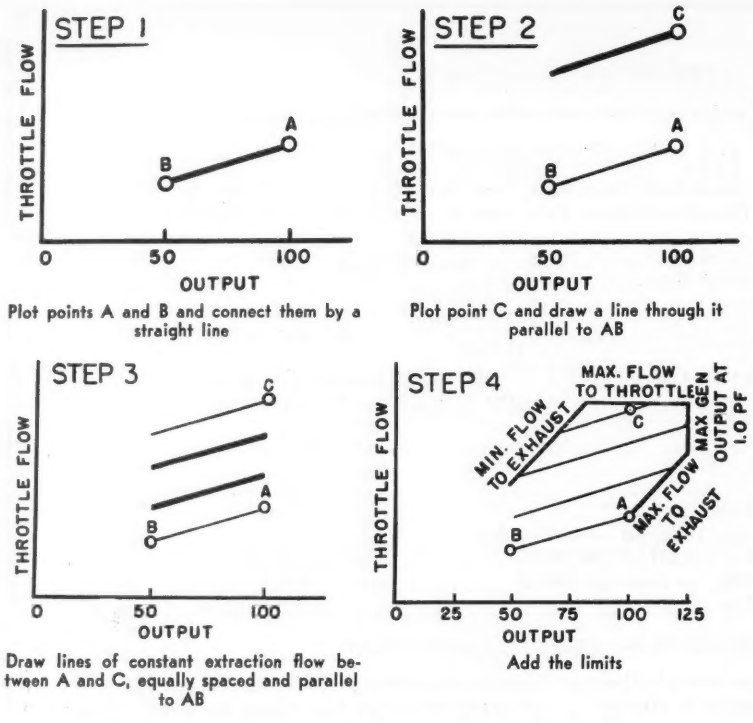


Chart 1. Step-by-step method of constructing performance chart

Theoretical Steam Rates (Table 1)

The theoretical steam rates given in Table 1 are based on representative initial steam conditions. Inasmuch as each column headed by both an initial pressure and an initial temperature, this condensed table is not well suited to interpolations.

Where steam conditions are other than those shown in this table, the theoretical steam rates may be derived from a Mollier chart[1] or read directly from a comprehensive set of theoretical steam rate tables such as those by Keenan & Keyes, published by the A.S.M.E. in 1938.

[1] Thermodynamic Properties of Steam, by Keenan and Keyes, John Wiley & Sons, Inc., N. Y., 1936.

Care could be used in determining the theoretical steam rates — they are factors that influence greatly the result.

Efficiency (Table 2)

This table gives an approximation of the full-load efficiency with no extraction for a single automatic extraction non-condensing turbine-generator set, of 50 or 60 cycles. Estimates made from this table will usually be within an error of about 5 per cent.

Half-Load Flow-Factor (Table 3)

The half-load flow-factors in Table 3 are approximations that assume that the throttle flow versus output curve at no extraction will be a straight line. The table assumes, too, that all turbines of the same rating, regardless of design, will have the same half-load-flow to full-load-flow relationship. Obviously this relationship is not a constant one, but the error introduced by this assumption is not appreciable, provided the performance chart is not extrapolated below one-half load.

Table 2. Full-load Non-extraction Efficiencies for Non-condensing Single-automatic Steam Turbines

Rating, in kw at 0.8 pf	Main Pressure, in lb./sq. in. g. 150	200	250	300	400	600	850
	Efficiencies						
500	.590	.580	.570	.560	.540	.500	...
625	.615	.605	.595	.580	.560	.520	...
750	.630	.620	.610	.595	.575	.535	...
1000	.655	.645	.635	.620	.605	.656	...
1250	.670	.660	.650	.640	.625	.585	...
1500	.680	.670	.665	.655	.640	.600	...
2000	.700	.690	.685	.675	.660	.630	...
2500	.710	.705	.695	.690	.675	.645	.620
3000	.720	.715	.705	.700	.690	.660	.635
3500	.725	.720	.715	.710	.695	.670	.650
4000	.730	.725	.720	.715	.705	.680	.660
5000	.735	.735	.730	.725	.715	.695	.675
6000	.740	.735	.735	.730	.725	.705	.685
7500	.745	.740	.740	.735	.730	.715	.700

Extraction Factor (Chart 2)

The ratio of theoretical steam rates (TSR_1 to TSR_2) is an empirical measure of the extraction factor. This relationship, and the assumption that all extraction charts are made up of straight lines, parallel to each other and equally spaced, makes possible this estimating method. Such an assumption introduces an error which is more than compensated for by the simplicity it makes possible in the estimating method.

The extraction factor is the portion of a pound of steam which must be added to the throttle flow for each pound of steam extracted. Its use is shown in the example.

Maximum Required Extraction Flow (F)

The maximum required extraction flow is part of the given conditions for each application of an extraction turbine. No problem is presented by this flow when it is small, but sometimes the desired extraction flow is beyond the turbine's capacity. In such a case the maximum throttle flow limit line (discussed under the heading "Max. throttle flow") will cut off the maximum extraction at the point where full-load is developed with minimum steam flow passing to the exhaust section.

When selecting a flow for the maximum required extraction flow (point F),

Table 3. Half-load Flow-factor

Rating in kw at 0.8 pf	Factor
500, 625, 750	0.640
1000, 1250, 1500	0.635
2000, 2500, 3000	0.630
3500, 4000, 5000	0.625
6000, 7500	0.620

it will be found desirable to pick a number easily divisible into smaller flows. This is apparent on Chart 5 where the 140,000 lb per hr flow has been divided into flows of 0, 20, 40, 60, 80, 100, 120, and 140,000 lb per hr for convenience in reading the chart.

Minimum Flow to Exhaust (Chart 3)

The chart of minimum flow to exhaust is plotted against extracton pressure with lines for different turbine ratings. It is not necessary to read this chart more closely then the nearest 500 lb per hr.

The minimum steam flow to exhaust is fixed either by the minimum safe

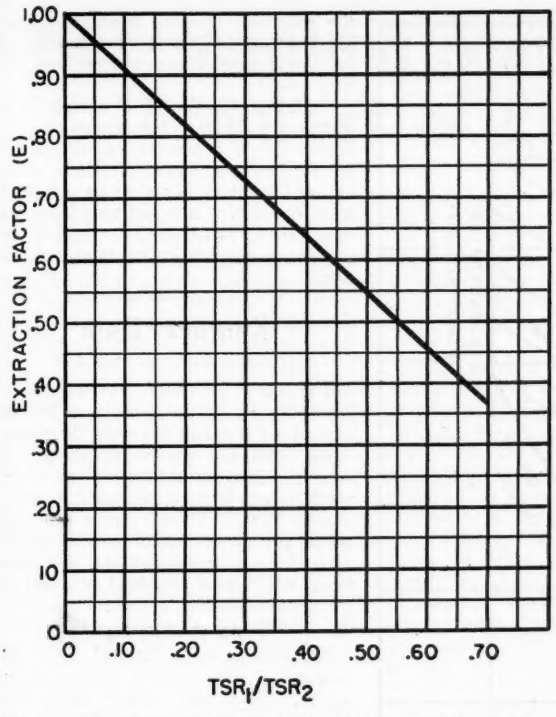


Chart 2. Extraction Factor versus Ratio of Theoretical Steam Rates

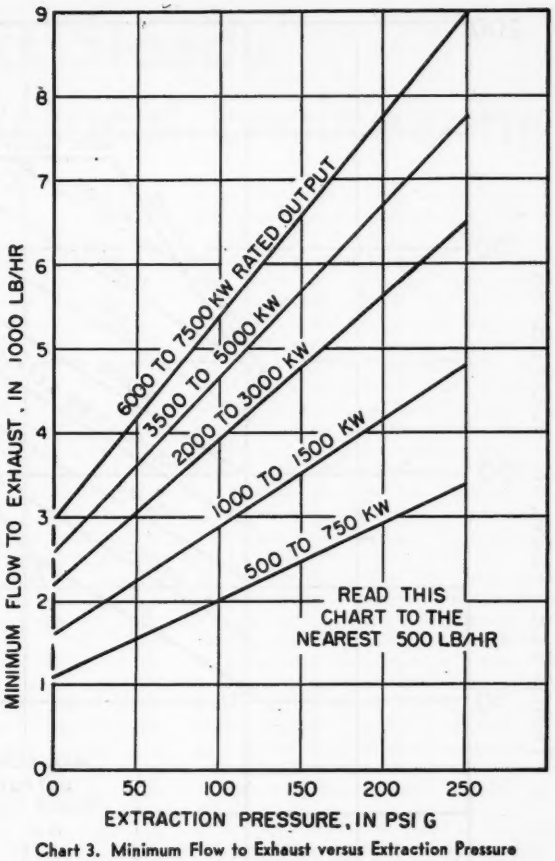


Chart 3. Minimum Flow to Exhaust versus Extraction Pressure

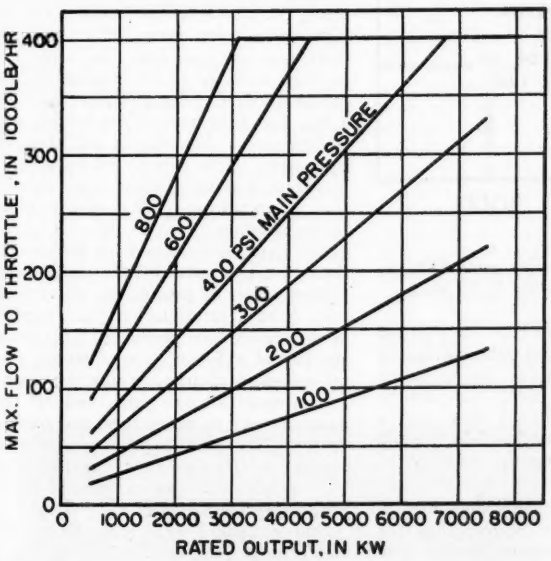


Chart 4. (Left) Maximum Throttle Flow versus Rated Output. Estimates should be limited to those coming within the maximum throttle flows shown on this chart

flow needed to cool the exhaust stages, or by the minimum flow that will leak around the shaft and through the extraction control valve under its closed condition.

Chart 1 gives the steps necessary to prepare the performance chart up to the point where limits are added. The first limit usually added to such a chart is the limit of minimum flow to exhaust, some times called the limit of maximum extraction inasmuch as it acts to limit maximum extraction. To add this limit to the chart, two or three points should be plotted on the lines of constant extraction flow where the throttle flow is equal to the extraction flow plus the minimum exhaust flow. Thus, on Chart 5, with a minimum exhaust flow of 5500 lb per hr, the point on the 140,000 lb per hr limit line will be at 145,500 lb per hr throttle flow; at 120,000 lb per hr extraction, the throttle flow will be 125,500 lb per hr; and, if the 100,000 lb per hr extraction line were extended it would meet an extension of the minimum flow to exhaust limit line at 105,500 lb per hr.

When placing limits on an extraction chart, it is helpful to recall that the flow through the high pressure section is the throttle flow; and that flow to exhaust is equal to the throttle flow minus extraction flow.

Comparison of performance obtained by this short cut estimating method with performance of actual turbines indicates that the greatest error may be expected for throttle flows read from the limit line of minimum flow to exhaust. This error, however, diminishes rapidly as points are read in the region to the right of this limit line. By adding steps to this method it would be possible to decrease this error, but inasmuch as the region of maximum error is small and the estimating method gives conservative results, it was thought best to tolerate this error.

Maximum Flow to Exhaust

The maximum flow to exhaust limit is added to the chart in exactly the same manner as the minimum flow to exhaust limit was added. In this estimating method the assumption has been made that all turbines will be designed with exhaust sections sufficiently large to enable the turbine to carry full rated output with the extraction pressure held constant but no extraction taken from the turbine. This is the usual practice with automatic extraction turbines although cases are occasionally encountered when it is better to make the exhaust section larger or smaller than the general rule.

In adding the maximum flow to exhaust limit,[2] the lines of constant

[2] Extraction performance charts with their limits are discussed in more detail in "Modern Turbines," by Newman, Keller, Wales and Lyons. John Wiley & Sons, Inc., N. Y., 1944.

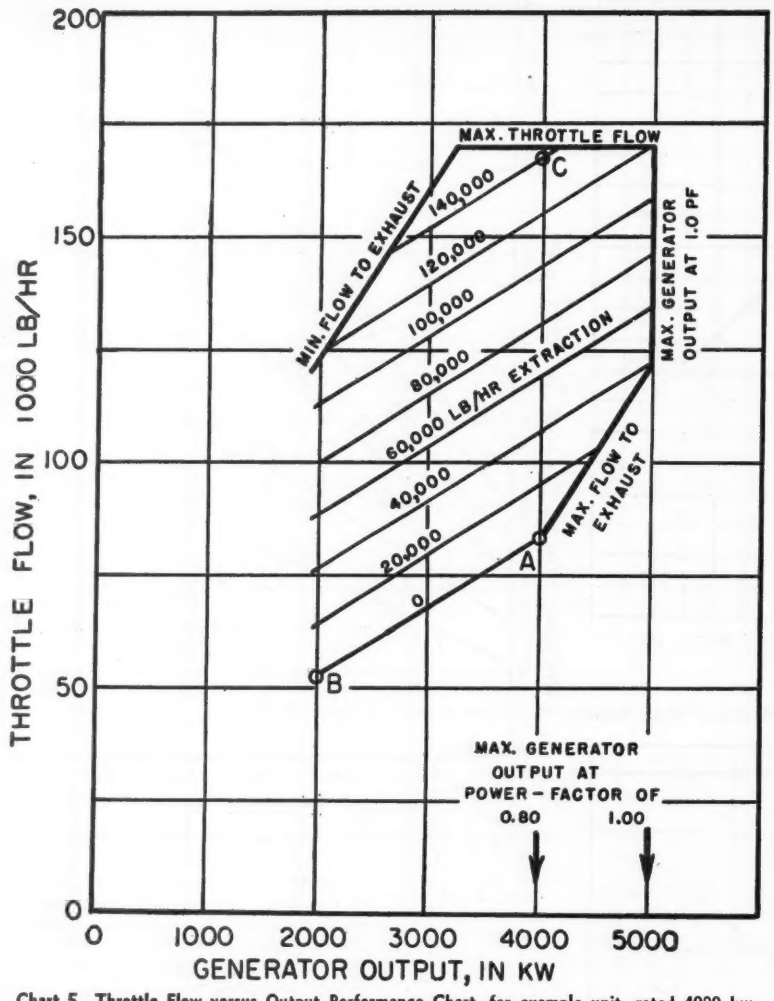


Chart 5. Throttle Flow versus Output Performance Chart, for example unit, rated 4000 kw. Steam conditions: 400 psi, g, 700 F, 20 psi, g, with automatic extraction at 150 psi, g.

extraction flow should be extended to the point where they are cut off by this limit or by the limit of generator output. Thus, on Chart 5, the 20,000 lb per hr extraction flow line is cut by the limit at a throttle flow of 103,400 lb per hr (20,000 lb per hr plus point A), but the 40,000 lb per hr extraction line is cut off by the limit of generator output, 5000 kw at 1.0 power factor.

Maximum Generator Output

The usual turbine generator set has an 0.80 power factor generator, and a turbine capable of carrying full kva on the generator at 1.0 power factor. This is indicated as 125 per cent capacity on Chart 1, and as 5000 kw at 1.0 power factor on Chart 5.

Maximum Throttle Flow (Chart 4)

The maximum throttle flow from Chart 4 is not a true limit in the sense that turbines of the ratings shown could not be built for higher steam flows. Rather it is intended as a warning that such a turbine would be of special design. So also is the limit imposed by a throttle flow equal to three times the full-load nonextration flow (that is, $3 \times A$). Both of these maximum throttle flow limits are exceeded by many actual extraction turbines, but performance of such machines is outside the range of this method. These limits will not be encountered often — when they are, a manufacturer's turbine specialist should prepare even the most preliminary of estimates.

This estimating method does not indicate any change in performance for differences in the maximum throttle flow alone. Actually, performance under a given condition will be better if the turbine is designed for a flow no greater than that required to meet the particular condition than if the turbine is designed for a flow much greater than needed. If, for example, performance Chart 5 had been estimated for 200,000 lb per hr extraction flow, the estimated throttle flow at 140,000 lb per hr extraction would remain unchanged, *on the basis of this method.* In an actual turbine, performance would be better for a turbine designed and operating at 140,000 lb per hr extraction, than for a turbine otherwise the same except designed for 200,000 lb per hr but operating at 140,000 lb per hr extraction. Because of this, the maximum throttle flow should be selected for the lowest value consistent with flexibility to meet present and future needs.

"GET THE FACTS!" should be a watchword before recommending the application of a non-condensing extraction type turbine. Always should be borne in mind the fact that they have limited heat rejection. But when conditions are right, these useful turbines will often pay for themselves in less than a year's time.

Kentucky Dam

(Continued from page 81)

mechanically through the secondary rooms and spaces. Approximately 125,000 cfm of air is exhausted from the power house with the excess introduced air escaping through the generator room hatch covers for heat removal. Approximately 22,000 cfm of air is also exhausted from the control building which, as previously mentioned, has its main ventilating system combined as a part of the air-conditioning system.

Air Conditioning

Provision is made for full air conditioning of the control room, public spaces, offices and related areas. Because of variations in the heating and cooling requirements of the different areas, the air-conditioned spaces are divided into three zones. Each of the individual systems may be used for heating, cooling, or ventilating as the season demands. Each system includes a fan, duct system, air filter, heating and cooling coils, humidifiers and control equipment. Heat is supplied by electric blast-type heaters. Cooling is by surface coolers employing chilled water as a cooling medium. Part of the cooling facilities have been omitted for the present time because of WPB restrictions. Chilled water is pumped to all cooling coils from a refrigerating plant located in the service bay basement. This plant consists of a Freon 12 compressor, water-cooled condenser, water cooler, chilled-water storage tank, and all the necessary pumps, accessories, and control devices. The plant has an approximate capacity of 66 tons of refrigeration at 35 F evaporation temperature and 101 F condensing temperature.

When designs were initiated for the Kentucky project, the late Colonel T. B. Parker was Chief Engineer of the Tennessee Valley Authority. He was succeeded by C. E. Blee in June 1943. The design work of the entire development was under the supervision of George R. Rich, Chief Design Engineer, with the mechanical design under the immediate supervision of H. J. Petersen, Head Mechanical Design Engineer.

IF STATISTICS count for anything, says the ural Electrification Administration, over $70,000,000 will be spent to put plumbing on farms which have electricity today and on farms and other rural dwellings which will be electrified under the proposed National 5-year Postwar Rural Electrification Program.

AIEE Meeting Marks Steady Progress of Electrical Engineering

THE WINTER MEETING of The American Institute of Electrical Engineers held in New York, January 22 to 26, indicated the steady progress of the electrical art in a wide variety of technical papers and discussions. No startlingly new developments were announced but all branches of the field reflected the continued refinement and perfection that inevitably results from the concentrated study and use of equipment in the field and laboratory.

As have been all of the AIEE meetings since the war started, this was entirely a technical meeting, one devoted largely to matters affecting the war effort. It was attended by over 1200 members and guests, many of whom were directly associated with our military and naval forces. Several sessions were entirely concerned with the design and operation of electrical equipment for aircraft and there was one conference on wartime distribution practices.

There were a considerable number of technical papers dealing in part, at least, with electronic equipment and for those interested in this branch of electrical engineering the Winter Technical Meeting of The Institute of Radio Engineers held on Thursday, Friday and Saturday of the same week at the nearby Commodore Hotel offered other excellent papers on industrial electronics applications. The AIEE meeting was held in the Engineering Societies Building.

Of particular interest to power engineers were the sessions on Power Generation, Central Station Auxiliaries, Circuit Breakers, Industrial Power Applications and Wartime Distribution Practices.

At the joint IRE-AIEE session on Wednesday evening, January 24, the Edison Medal was presented to Dr. E. F. W. Alexanderson of the General Electric Company. The presentation was made by A. A. Powell of Westinghouse, President of the AIEE. The award was made for Dr. Alexanderson's outstanding inventions and developments in the radio, transportation, marine and power fields.

At the general session on Wednesday morning, the Alfred Nobel Prize was awarded to W. R. Wilson of the General Electric Co. for his paper "Corona in Aircraft Electric Systems as a Function of Altitude." At this session, also, Dr. Dugald C. Jackson was presented with a certificate of Honorary Membership in the Institute. After these presentations, J. Carlton Ward, Jr., President and Director, Fairchild Engine and Airplane Corporation delivered an interesting address entitled, "Research and its Effect on Winning the War." Mr. Ward pointed out that many of us in this country are too apt to assume that the United States has led the world in the type of research that is winning the war for us. As a matter of fact, most of the developments which mean so much in this war took place in other countries. Such developments as radar, jet propulsion, rocket projectiles and rocket planes, etc., were all developed outside of the United States. He warned that unless we, as a nation, embarked on a serious and long range military research program after the war, we would suffer the consequences for the lack of such a program in years to come. If we had had B-29's and well developed radar at the time of Pearl Harbor, there would have been no surprise attack by Japan, in fact Japan never would have dared to attack us.

At the Circuit Breaker session A. W. Hill and W. M. Leeds, both of Westinghouse, presented a paper on modern circuit breaker performance, which pointed out that cricuit breakers of 5,000,000 kva interrupting capacity would be available when the need for them arises. At the present time circuit breakers of 3,500,000 kva are available, in fact, there were two papers at this session describing two different types of 3500 mva breakers. One of these breakers was a 3-cycle, 3500 mva air-blast breaker for 138 kv service and the other, an oil breaker of the same capacity and designed for the same voltage. Both of these units were General Electric Co. developments. The air-blast breaker was described by H. L. Byrd and B. S. Beall. Results of laboratory tests indicated that the breaker was fully capable of meeting an interrupting time of 3 cycles and the unsually high speed reclosing duty for which it was designed. It interrupted fault current within its rating and re-established the circuit within approximately 14 cycles. Field tests of these breakers made on the lines of the Ohio Power Co. substantiated the results of the laboratory tests.

The 3500 mva, 3-cycle, 138 kv oil breaker was described in a paper by H. L. Byrd and E. B. Rietz of General Electric. This unit has a reclosing time of less than 20 cycles. In laboratory tests on these breakers, interruption at 23,000 amp corresponds to 5500 mva at 138 kv, but the authors said that the final design of a 5000 mva breaker would require further development. Present available data, however, give the assurance that a 5000 mva breaker is practical and can be built when the need exists.

Another interesting development in circuit breaker design disclosed at the meeting was the 6-pole, 1600 amp, 175-v,

Fig. 1. E. F. W. Alexanderson (right) receiving the Edison Medal from C. A. Powell, President of the AIEE

Fig. 2. H. A. P. Langstaff, West Penn Power Co.; H. N. Muller, Westinghouse; J. E. Hobson, Armour Research Foundation; C. F. Wagner, Westinghouse; and E. Huntington, Rochester Gas & Electric

anode circuit breaker, described by E. W. Boehne and W. A. Atwood, both of G. E. This unit is designed to operate in the anode circuit of mercury-arc rectifiers to repeatedly interrupt arc-back currents up to 90,000 amp at rates of rise in excess of 11,000,000 amp per second. Chief among the breaker improvements is a new arcing contact arrangement with a new streamlined arc interrupter which does not require the use of blow-out coils for current interruption.

Central Station Auxiliaries

The conference on central station auxiliaries was informal but it brought forth much interesting discussion on trends in the design and use of central station auxiliaries. As was pointed out by V. E. McCallum of the Commonwealth Edison Co., the modern central station is its own best customer; it uses from 5 to 7 per cent of its output in driving the auxiliaries. Nearly all of the auxiliaries are motor driven.

There is a general trend toward unit designs of stations and the use of 440 v and 2300 v, the latter for motors over 150 hp. The importance of keeping the systems simple was emphasized by Mr. McLain of Burns & Roe. As pressures and temperatures went up, Mr. McLain pointed out, they came virtually to a one "bus" or pipe system and he thought perhaps we should do the same on the electrical side of the system.

The old question of the house turbine vs the use of separate steam driven auxiliaries still involves difference of opinion and no definite conclusions were arrived at in the discussion. At least one operator was of the opinion that the house turbine was the most reliable arrangement. With a lot of steam driven auxiliaries around the station, all hogs for steam, resulting in lowered steam pressure at the very time normal pressure was needed, steam driven auxiliaries, the speaker pointed out, were more of a liability than an asset. The lowered steam pressure caused more trouble than loss of synchronism.

The question of putting more than one motor on one circuit breaker was brought up but was not regarded favorable by manufacturers' representatives. It was suggested that the forced- and induced-draft fan motors could be fed through one circuit breaker. While this could be done, it was hardly considered worth while. At Southwork station, for example, the induced-draft fan motors were 1500 hp and the forced-draft fan motors, 900 hp. Such motors are big enough to stand alone.

Machinery Insulation

One of the most interesting sessions of the meeting was the one devoted to Machinery Insulation. Two of the papers presented at this session discussed the nature of Silicones and their application to electrical machinery as insulation. Silicones are a class of materials—organo-silicon compounds—made of sand, brine, coal and oil which give promise of a wide variety of uses. One of the important characteristics of silicones is their ability to withstand high temperatures without deterioration. Since their electrical insulating qualities are also extremely good, they offer attractive possibilities in the electrical machinery field. T. A. Kauppi of the Dow-Corning Corp., and G. L. Moses of Westinghouse, described the nature and production of Silicones in a paper entitled Organo-Silicon Compounds for Insulating Electrical Machinery, and J. DeKiep, L. R. Hill and G. L. Moses described the Application of Silicone resins to insulation for Electrical Machinery.

An interesting fact regarding the use of the silicone is that a machine insulated with these compounds will fail from causes other than failure of the insulation due to high temperatures. Mr. Fuller of The Reliance Electric Co., cited instances where the hardened steel races on ball bearing motors have shown signs of softening at temperatures of 200 C. Ordinary bearings will fail at 125 C.

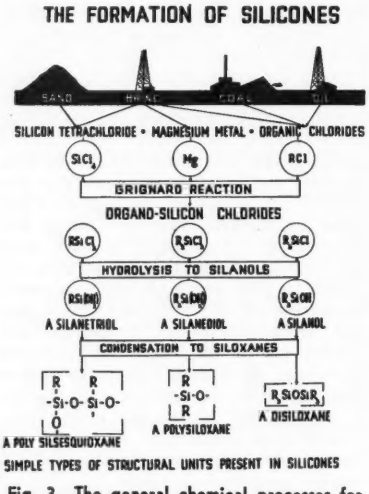


Fig. 3. The general chemical processes for the formation of silicones from sand, brine, coal and oil

At the present time silicone resins are not available in quantity and the price is high, about $3.65 per lb for the resins and about $15 per gal for liquid. Strangely enough these same silicones can serve as lubricants. As lubricants, they undergo little deterioration at high temperatures and they suffer practically no change in viscosity. A production plant is now being placed in operation by Dow-Corning and it can be expected that the price will be reduced. F. E. Phillips of General Electric, called attention to the fact that temperature rise is not the only criterion by which the value of silicones as insulation should be measured. He predicted that development in the use of silicones will be along lines other than temperature rise. J. G. Noest of Consolidated Edison Co. of New York, seemed enthusiastic about the possibilities of silicones from the operating man's viewpoint. He saw in the development the promise of a motor which will not only withstand high temperature and resistance to moisture but with it a lubricant that will retain its desirable characteristics at high ambient temperatures. Resistance to moisture he pointed out was extremely important in motors installed in boiler plants. In two cases of boiler tube failure, Mr. Noest said the 600 hp, induced-draft fan motors failed in two minutes due to the absorption of moisture. He was curious, however, regarding the abrasion resistance of silicones as considerable trouble has been experienced with fly ash in large boiler plants. G. L. Moses pointed out that no trouble with abrasion had been experienced in operating 50 motors ranging in size from 5 to 3000 hp. In answer to questions regarding operation of silicones under high voltage and resistance to ionization, T. A. Kauppi said that no recommendations could be made in this respect because of lack of experience, but it is known that it is ozone-resistant.

Industrial Power Applications

The two sessions on industrial power applications on Thursday, January 25th, covered a variety of subjects. The first two papers at the morning session were devoted to a description of electrically controlled milling machines for machining large ship propeller blades. In the past, the surfaces of such propellers which may run 24 ft in diameter have been finished almost entirely by hand. The recently devoloped Morton ship-propeller milling machine has provided Naval designs with a tool that will accurately generate the contours of both sides of a propeller blade simultaneously at a tremendous saving in time and effort. The application of wide range, adjustable speed d-c motors, and a new and unique electric position regulator, and modern full magnetic control have made the machine possible. The machine was described in a paper by H. Earl Morton of the Morton Mfg. Co., Muskegon Heights, Mich., and Oren G. Rutemiller of the Crosley Corp., Cincinnati. The Tracer controlled position regulator for the machine was covered in a companion paper by C. R. Hanna and W. O. Osbon, both of Westinghouse, and R. A. Hartley of the Adel Precision Products Co. of Burbank, Cal.

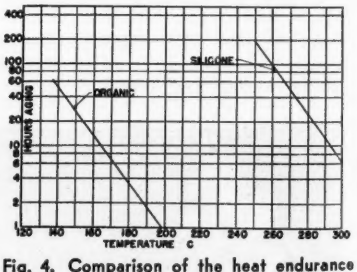


Fig. 4. Comparison of the heat endurance of organic and silicone varnishes

M. M. Morack of General Electric, described the design of a new sealed-in ignitron rectifier for 3-wire service. As Mr. Morack put it, the mercury-arc rectifier was the first electron tube to put on overalls and go to work. Today there is scarcely a spot in industry where rectifiers are not used. In 1943, something around 43 billion kwh, 1/10 of all the power used in this country, went through mercury-arc rectifiers. Two-wire sealed-in rectifiers in the range of 75- to 1000-kw capacity at voltages be-

Fig. 5. A. L. Van Emden, U. S. Navy Bureau of Ships; J. De Kiep, Westinghouse and Scott Hancock, Westinghouse

tween 250 and 600 v, d-c, have found wide application in industry during the war years. Now, with the development of a 3-wire sealed-in rectifier the field of application will be considerably enlarged. This paper was the subject of considerable discussion. Among other things, the question was raised as to whether mercury-arc rectifiers could run in parallel with motor-generator sets? Mr. Umansky of the General Electric Co., answered this question in the affirmative. He reported that there were several large installations where such parallel operation was in effect.

At the afternoon session on industrial power applications, there were two papers describing electric power distribution systems in large war plants. E. L. Bailey of the Chrysler Corp. gave a paper on the Dodge Chicago Plant's electric power distribution scheme with airplane engine testing power recovery while R. H. Kaufman of G. E., and N. A. Kieb of Pratt & Whitney Aircraft Corp., described the distribution system used at the Kansas City Pratt & Whitney aircraft engine plant.

Instruments and Measurements

At the Instruments and Measurements session, an interesting paper by F. W. Atkinson and R. B. Taylor of the Takk Corp., described a new cold cathode high-voltage rectifier tube for measuring insulation resistance at high voltage. The complete instrument weighs only 31 lb. and is, therefore, portable. There was considerable interest in this testing set and there seemed to be general appreciation of the fact that the development of this machine represented a notable advance in the art. T. B. Whitson of the J. G. Biddle Co., said that the tester in its present form would probably be useful on bushings and other low capacitance parts.

The authors of the paper pointed out that the tester was not designed to be a dielectric absorption tester, but that it could readily be developed into one. Regarding a question as to the effect of backfires, Mr. Atkinson said that backfires do no harm to the tubes. The tube life is unknown, but some of the units have been in use for 4 yr and they seem to be as good as ever.

While there were comparatively few papers of a purely electronic nature, many papers involved electronic applications and there was one, devoted to the principles of grid control for thyratrons that had considerable merit. This paper, presented by P. H. Chin and E. E. Moyer, both of General Electric, was intended as a preamble to a study of practical circuits for grid control of thyratrons. In addition to a detailed discussion of the basic methods of grid control, it included the control characteristics of thyratrons with an alternating potential applied to the anode.

Power Generation

At the Power Generation session the proposed preferred standards for large 3600 rpm turbo-generators was presented by a joint AIEE-ASME Committee. atings of 11,500; 15,000; 20,000; 30,000; 40,000; and 60,000 kw have been proposed. It is hoped that by standardizing on these capacities that manufacturers will be able to reduce costs. While there was tacit acceptance of these proposals there was still criticism and several revisions were proposed. There was some discussion regarding the use of higher hydrogen pressures in generators. E. E. George pointed out that there was too much reluctance to partake of the advantages of the use of high hydrogen pressures.

Lightning and Protective Relaying

Curiously enough, one of the most important papers to be presented at the meeting was one by a woman. Edith Clarke's paper, "Impedances Seen by Relays During Power Swings with and wtihout Faults," for the first time provides transmission line engineers with a method for visualizing the phenomena with which relays have to contend during power swings. Miss Clarke devised impedance circles by which the relay man can easily, without the use of pencil and paper, determine the behavior of distance relays on a given system. Thus, he can select relays having characteristics best suited to a specific application. Miss Clarke's paper was accorded high praise. F. C. Poage of Ebasco Services, commenting on the paper, said that it crystallized vividly the nebulous empirical guesses of the relay engineer.

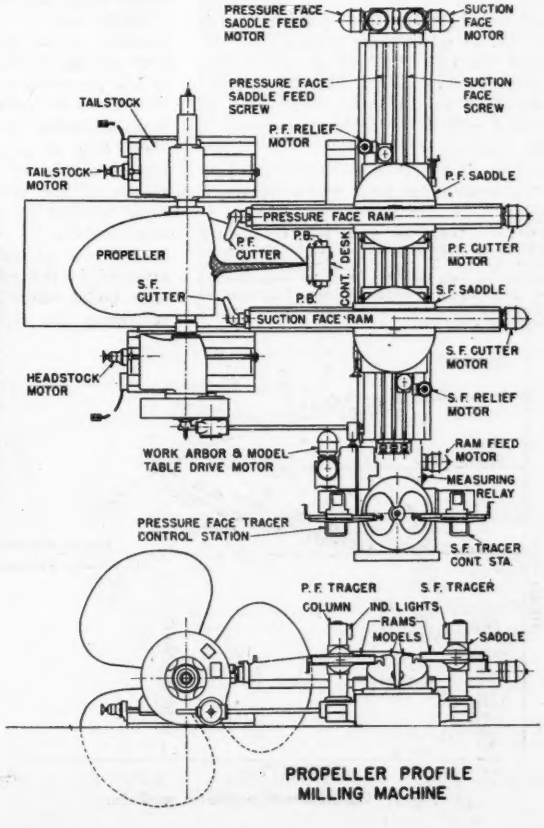


Fig. 6. Side elevation and plan view of propeller milling machine described by Morton and Rutemiller. The machine is equipped with 11 motors and 3 motor generator sets. Practically all of these motors operate in a definite sequence when the machine is performing in an automatic cycle

Centrifugal Pump Control

Part IV

Controls for centrifugal boiler feed pumps illustrate most of basic principles of all pump control . . . Detailed analysis of problems in boiler feed pump control . . . Function of feedwater regulator . . . Uses of differential or excess pressure regulators . . . Control of motor-driven and turbine-driven pumps . . . Master control of several boiler feed pumps in parallel.

By Igor J. Karassik *Application Engineer, Worthington Pump & Machinery Corp.*

THIS SERIES of articles cannot hope to serve as an exhaustive catalogue of all the forms and types of control equipment which an engineer may encounter in his career. Instead, their purpose is directed at the understanding of the various functions which pump controls may be called upon to perform and of the effect the operation of these controls may have on the performance of centrifugal pumps. Therefore, the writer felt that if the power plant engineer were given a complete explanation of the functioning of centrifugal pump controls in one specific field of application, he would be able to understand more clearly other types of control applications. For this reason and because power plant engineers are most frequently confronted with the control of centrifugal boiler feed pumps, it was decided to select these controls for detailed analysis. Control of boiler feed pumps presents such a diversity of problems that almost every basic type of control will be properly represented in this analysis.

*All republication rights reserved by author.

†Part I, December, 1944; Part II, January, 1945; Part III, February, 1945. This present series by Mr. Karassik, originally planned to consist of four articles, will be extended by the publication in future issues of articles on Protective Controls and The Technique of Applying Controls.

We may first approach this study by considering the problems involved. One of the most important requirements in the operation of modern steam generating units is the maintenance of a constant water level in the boiler drum, irrespective of the fluctuation of the load imposed upon the boiler. At the same time, this constant level should be maintained without undue fluctuations in the feedwater flow. The importance of this requirement is further emphasized by the fact that modern boilers have considerably less water storage space than older types of boilers. If the water level is not maintained within safe limits, the operation of the boiler will be affected seriously. Surges in the water level may result either in water getting into the steam header, in overheating and failure of boiler tubes or in surges in the boiler pressure, thus affecting the operation both of the combustion equipment and of the prime movers.

Serious troubles will likewise result from an undue fluctuation of the feedwater flow by occasioning severe hunting of the boiler feed pumps, possible failure of the suction supply and unequal heating of the feedwater in the stage heaters.

In order to understand the problems involved in the maintenance of a constant boiler water level, it is essential to remember the statement made in the first of this series of articles; namely, that a centrifugal pump operates on a system head curve. In other words, it operates at a capacity and pressure corresponding to the intersection of its head-capacity curve with the system head curve. Thus, in a given feedwater system, if the static pressure (boiler drum pressure plus static elevation) and the friction losses remain constant, the boiler feed pump will deliver a constant capacity into the boiler.

This, however, will not permit the maintenance of a constant boiler water level, inasmuch as the steam outflow from the boiler is not constant but depends on the turbine load.

Regulator an Artificial Source of Friction Loss

It becomes necessary, therefore, to introduce an artificial source of friction loss, this friction loss being controlled by the changes in the level of the water in the boiler drum. This artificial source of friction loss is provided by the **Feedwater Regulator.** While the operation of such a regulator could, in a few isolated cases, be handled manually, it is a well known fact that automatic operation of this control is required in all but a few extremely small installations.

Consequently, the feedwater regulator consists basically of two elements:

(a) A throttling valve
(b) A controlling mechanism, which determines the setting of this valve, depending on boiler level fluctuations.

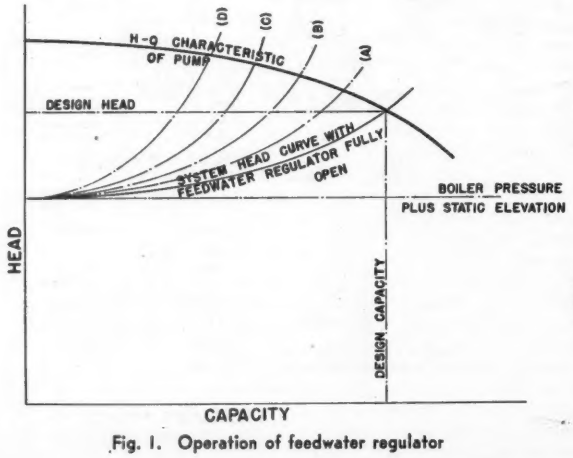


Fig. 1. Operation of feedwater regulator

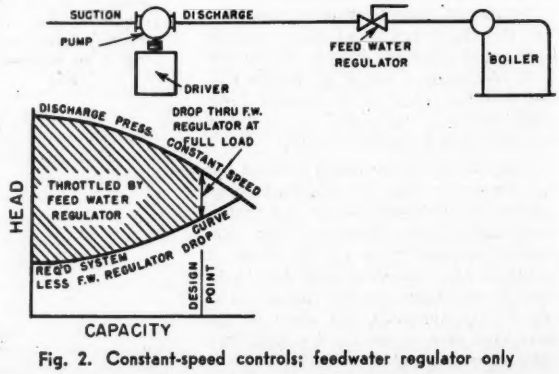


Fig. 2. Constant-speed controls; feedwater regulator only

Figure 1 represents the operation of a centrifugal boiler feed pump at constant speed and illustrates the effect of the feedwater regulator throttling valve at several different positions corresponding to various flow requirements of the boiler. It will be noticed that this figure duplicates Fig. 2 in the Part II of this series†, where the operation of throttling valves was described to illustrate one of the fundamental pump control functions. It has been assumed in this case that the boiler pressure is constant at all loads. Thus, depending on the boiler load and consequently on the position of the feedwater regulator throttle valve, the pump discharge capacity will correspond to the intersection of the head-capacity curve with curves (A) to (D) or with any intermediate curve.

The feedwater regulator represents the simplest but most important of boiler feed pump controls; without it, boiler feeding would have to take place manually, an operator watching the boiler gauge glass and opening or closing a valve as he saw the level fall or rise. Of course, if the centrifugal pump were to operate at variable speed, the throttling required of the feedwater regulator would be reduced. But a control depends somewhat on the degree of refinement it is desired to achieve in the solution of the problem at hand and variable speed operation of feed pumps is one such refinement which will be discussed later. For the purpose of a direct comparison between the simpler and more complex forms of control, there is shown, in Fig. 2, the conditions prevailing in a feedwater system where the pumps are operated at constant speed and where the only control is a feedwater regulator.

Types of Feedwater Regulators

There are a great many feedwater regulators on the market today. Obviously, the specific manner in which boiler level fluctuations are transmitted to the throttling valve as well as the design of the valve itself vary with each manufacturer. For the purpose of illustration, two typical designs of feedwater regulators are analyzed in the following paragraphs.

Feedwater Regulator, Type I.—The feedwater regulator shown on Fig. 3 consists of a generator and a feedwater regulating valve. The generator has a central pipe "A". The top of this pipe is connected to the boiler drum above the water line and the bottom is connected below the water line. Thus, the water level in pipe "A" is exactly at the same height as the water level in the boiler drum.

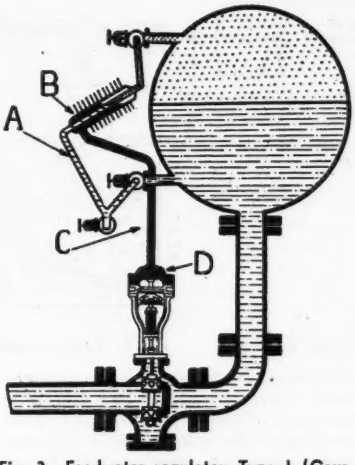


Fig. 3. Feedwater regulator, Type I (Courtesy Swartwout Co.)

Around this central pipe is another chamber "B", open through connecting tubing "C" into diaphragm chamber "D". There is no connection between this outer chamber "B" and the central pipe "A". The water in the lower part of the central pipe "A" is relatively cool, while the steam in its upper part is, of course, hot. The heat from this steam is transmitted through the walls of pipe "A" to the water in the outer chamber "B". This heat evaporates a portion of the water in the outer chamber "B" and the pressure thus created is transmitted through the connecting tubing "C" into the diaphragm housing "D". The increased pressure on the diaphragm counteracts the action of the spring and opens the valve.

The lower the water level goes in "A", the more water is evaporated in "B" and the greater the pressure exerted on the diaphragm of the feedwater regulator. Then, as the water level rises in "A", steam condenses and relieves the pressure in "B" causing the valve to begin to close. Steel radiators are placed on the outside of the generator to cause the steam in "B" to condense more rapidly.

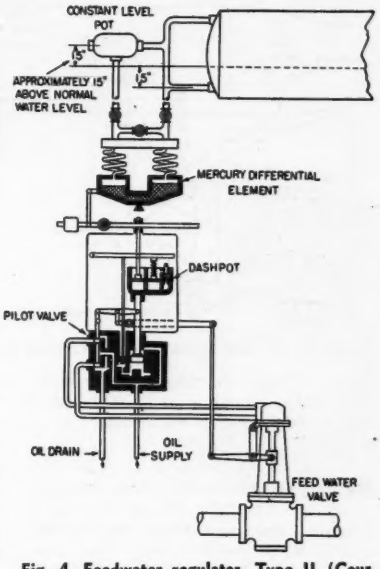


Fig. 4. Feedwater regulator, Type II (Courtesy Republic Flow Meters Co.)

Feedwater Regulator, Type II.—In this case, Fig. 4, the level measuring element is a mercury differential measuring device. It consists of two mercury reservoirs, cross-connected at the bottom to form a U-tube and pivoted on a knife-edge fulcrum. Any motion of this U-tube is transmitted by a pushrod to the weighbeam of the regulator. One leg of the U-tube is connected by flexible tubing to the bottom of the water space in the boiler drum; the other leg is connected to a constant level reservoir which, in turn, is connected to the steam space in the boiler drum.

The differential pressure created by the difference in level between the constant level reservoir and the normal drum level displaces the mercury in one leg of the U-tube, this displacement being balanced by a weight on the regulator weighbeam, so that when the water

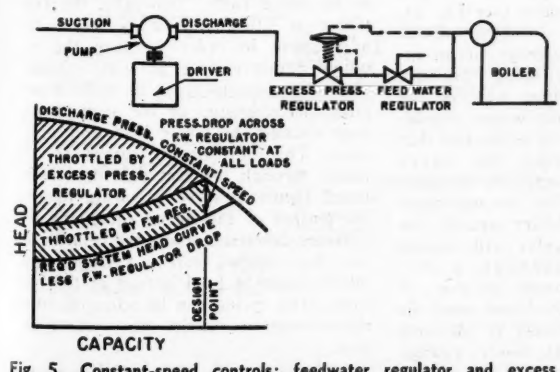


Fig. 5. Constant-speed controls; feedwater regulator and excess pressure regulator

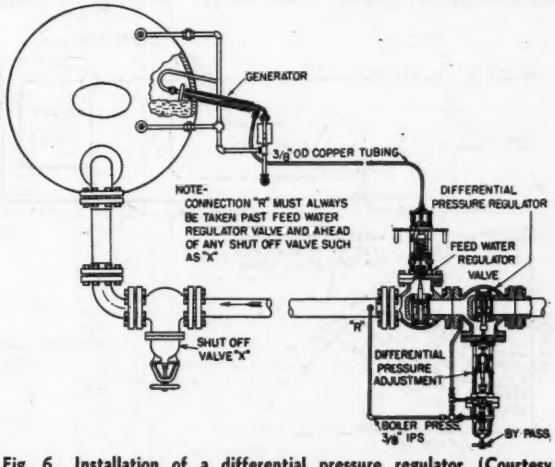

GENERATOR
3/8" OD COPPER TUBING
NOTE- CONNECTION "R" MUST ALWAYS BE TAKEN PAST FEED WATER REGULATOR VALVE AND AHEAD OF ANY SHUT OFF VALVE SUCH AS "X"
DIFFERENTIAL PRESSURE REGULATOR
FEED WATER REGULATOR VALVE
"R"
SHUT OFF VALVE "X"
DIFFERENTIAL PRESSURE ADJUSTMENT
BOILER PRESS. 3/8" IPS
BY PASS

Fig. 6. Installation of a differential pressure regulator (Courtesy Bailey Meter Co.)

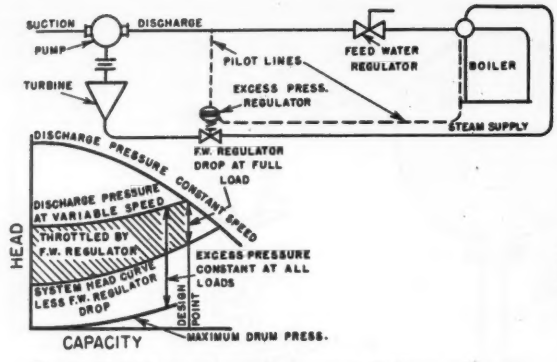


Fig. 7. Variable-speed controls; constant discharge pressure

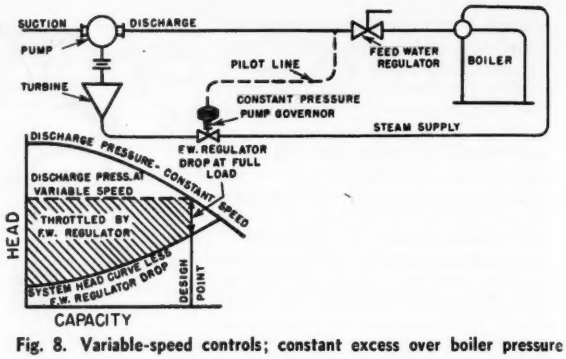


Fig. 8. Variable-speed controls; constant excess over boiler pressure

level is normal, the U-tube is in equilibrium. Any deviation of the drum level from normal will tilt the U-tube on its fulcrum.

If the boiler drum level falls, the right leg of the mercury U-tube becomes heavier and the tube tilts to the right. The tilt causes the right side of the weighbeam to move down. This motion, transmitted through a guide beam, multiplying valve and amplifier piston, operates the regulating valve, moving it the necessary amount and in the proper direction to restore the boiler water level to normal. Then the U-tube is again in balance and the power piston of the regulating valve in the new control position. Rise of water level, of course, reverses all the above motions. A stabilizing mechanism consisting of two oil dashpots prevents the system from hunting.

Feedwater Regulator, Type III—In a third feedwater regulator, the actuating element is a thermostatic expansion tube. This tube is connected to the boiler in the manner as in the case of Fig. 3, the water level in the tube corresponding to the water level in the boiler. The upper end of the tube is filled with steam, while the lower end is filled with water, which is at a lower temperature than the steam because of the radiation losses. This temperature difference between the steam and the water is used to operate the feedwater regulator.

As the water level in the boiler lowers, more steam enters the tube, which expands. If the boiler water level rises, on the other hand, more water enters the tube and the tube contracts. The expansion and contraction of the tube act as a thermostatic relay and transform the movement of the water level into a force which actuates the feed control valve.

Differential or Excess Pressure Regulators

The constant boiler level feedwater regulator can be likened to an orifice in a pipeline through which flows the feedwater. The quantity of flow through this orifice obviously depends upon the area of this orifice and the pressure drop across it. As the water level in the boiler rises or falls, the regulator valve moves so that the valve opening is such as to provide the correct rate of feed to the boiler. However, if the pressure drop across this valve is allowed to vary, there will be variations of flow through the valve, even though the area remains constant. While these variations in flow will eventually result in changing the boiler level and consequently the area of valve opening, such variations have an undesirable effect on the boiler load, inasmuch as the flow should vary only as required for load changes.

Inasmuch as the discharge pressure of a centrifugal pump operated at constant speed increases from 10 to 20 per cent between its design condition and extremely low flows, while the required system head decreases as flow decreases, the excess pressure over the system head curve increases very appreciably at light loads. This excess pressure must be absorbed in the feedwater regulator valve and will result in a very wide variation in the pressure drop across this valve (see Fig. 2).

Another disadvantage of an increasing pressure drop across the feedwater regulator is the fact that since the valve ports are designed for the maximum boiler capacity, the valve will operate through a very small portion of its travel when the boiler is operating at lower ratings, with a resulting sacrifice of control.

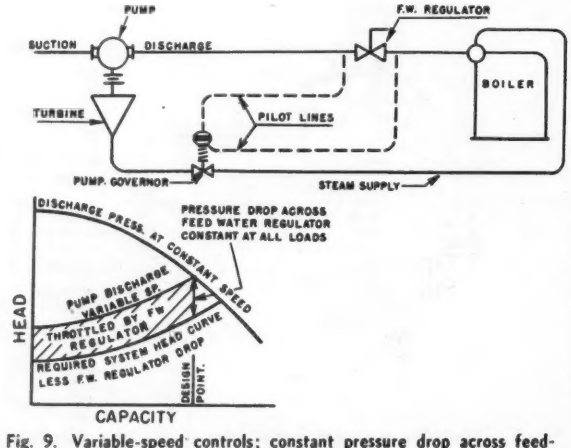


Fig. 9. Variable-speed controls; constant pressure drop across feedwater regulator

To obviate the disadvantages of a varying pressure drop across the feedwater regulator, recourse is had to **differential** or **excess-pressure regulators.** The function of this control is to maintain a more or less constant pressure drop across the feedwater regulator valve by means of one of the following principles:

(a) Throttling the excess pressure generated by the feed pump. This is used when the pump is operated at constant speed.

(b) Decreasing the pressure generated by the pump at various loads by varying the pump speed.

To visualize how an excess-pressure regulator maintains a uniform pressure drop across the feedwater regulator control valve, comparison can be made between Fig. 2 and Fig. 5, which shows both the hook-up of this refinement in pump control and the pressure and capacity relations in a feedwater system fitted with an excess-pressure regulator.

Methods of Using Differential-Pressure Regulator

A diagrammatic installation of a differential pressure regulator is shown on Fig. 6. Basically, it consists of a throttling valve located ahead of the feedwater level regulator valve. This throttling valve is actuated by a metal bellows subjected to and influenced by the differential water pressure, as the two sides of the bellows are connected to the upstream and downstream sides of the feedwater regulating valve respectively. As the pressure drop across the feedwater regulator valve increases, the differential pressure regulator closes until the pressure drop is again restored to its initial value. Generally, the regulator is fitted with a provision for adjustment, in order to vary the required pressure drop at will, compensating for various types of boiler operating characteristics or for semi-permanent changes in boiler load and pressure. This adjustment feature is obtained through the fact that the differential regulator valve is spring loaded, the tension of the spring equalizing the pressure difference across the bellows or, for that matter, across a diaphragm, which might be used instead of the bellows. The spring can be adjusted from the outside even in the course of operation.

Of course, the differential pressure regulator valve should be located as far

from the pump and as close to the feedwater regulator as possible, in order to minimize the pressure variation due to friction losses in the intervening piping and closed heaters. However, this is not always possible, and the regulator is often located almost immediately following the boiler feed pump discharge.

In some cases, instead of maintaining a constant pressure drop across the feedwater regulator, a constant discharge pressure is maintained at the boiler feed pump discharge. This form of control differs but little from that described in Figs. 5 and 6. Instead of being actuated by a difference of pressures across a diaphragm, the regulator is acted upon by the pump discharge pressure on one side and a constant pressure set up by a spring or an air loading mechanism, this constant pressure corresponding to the desired value at full load.

Control of Variable-Speed Pumps

When a centrifugal boiler feed pump is driven by a variable-speed motor or, especially, by a steam turbine, it becomes possible to apply the differential pressure control to even greater advantage. Figures 7, 8 and 9 show three different arrangements, all embodying a steam-turbine-driven boiler feed pump with a variable-speed governor. In all cases it has been assumed that the boiler drum pressure is not constant but increases with the load so as to maintain a constant steam pressure at the superheater outlet, the increase in drum pressure compensating for increased superheater losses at increasing steam flows.

It will be noted that the three arrangements differ only in the location of the pilot lines leading to the governor. In Fig. 7, representing a constant pressure governor, applied to the steam turbine driving the boiler feed pump only a pilot line to the discharge from the boiler feed pump is provided and the discharge pressure remains constant at all loads. In Fig. 8, which shows a constant-excess-pressure governor, the pilot lines lead to the pump discharge and to the boiler, respectively, thus varying the pump speed in such a manner that the difference between the pump discharge pressure and the boiler pressure remains constant at all loads. The feedwater regulator pressure drop is not constant, but throttles the difference between the pump discharge at variable speed and the pressure representing the system head curve less feedwater regulator drop.

Finally, in Fig. 9, the pilot lines lead to the two sides of the feedwater regulator, so that the pump speed varies in order to maintain a constant pressure drop across this valve. All these pump governors can be arranged to operate separate valves in the steam line ahead of the turbine governor valve, or to operate the turbine governor valve itself. A typical excess pressure pump governor mounted on a steam turbine and actuating the turbine governor through a linkage is illustrated in Fig. 10.

Similar controls can, of course, be applied to vary the speed of electric motor-driven centrifugal pumps, if these motors are of the slip-ring wound rotor type. Such applications, however, are relatively rare, therefore little more need be said of this application.

Two and Three-Element Feedwater Regulators

In the preceding descriptions, it was assumed that the feedwater regulator was of the simple level, or single-element type design. Actually, at the present time, a great number of installations use a somewhat more refined construction of feedwater regulator, in order to obtain closer control of boiler operation.

The "steam-flow type" or two-element regulator functions primarily on the basis of steam flow rather than on that of boiler level changes. In this arrangement, the regulator is enabled to anticipate level changes and stabilize the level at the desired value. This value itself is determined by the superimposed action of the level-element portion of the control. The steam-flow element is actuated by the pressure drop across an orifice in the steam outlet line or across the superheater section of the boiler.

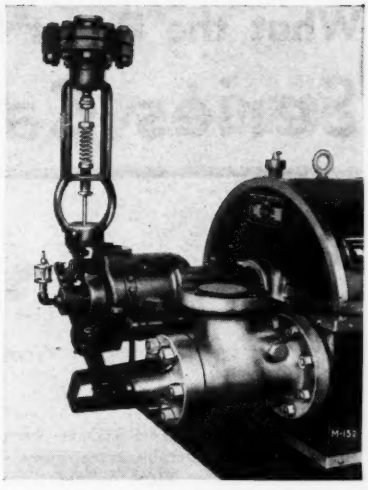


Fig. 10. Excess-pressure pump governor mounted on steam turbine

The three-element regulator superimposes the feedwater flow action over that of the two-element regulator, the third element adjusting the feedwater regulator valve to the opening required to give the rate of feed called for by the first two elements. It must be added that neither the two-element nor the three-element regulators differ in their effect on pump performance from the action of the single element regulator. The differentiation between the three types is mainly directed at the control of the boiler characteristics, therefore they need not be discussed further.

Master Pump Control

In most installations involving several boiler feed pumps, master controls are used instead of supplying each feed pump with its own measuring and impulse mechanism. Master controls present numerous advantages, among which the most important is a greater uniformity of operation between the several pumps.

The primary objective of such master controls is to reduce the power consumption of a group of pumps to the minimum. In large stations where such a group of pumps may be installed, the prime movers driving the pumps may have a capacity of several thousand horsepower or kilowatts. Hence any power saving in the operation of these pumps may produce a material reduction in the cost of operation. But the individual pumps and prime movers of the group may not all have identical characteristics. The master control system, therefore, is designed to carry out three principal functions:

1. To maintain automatically the desired excess of feedwater pressure over steam pressure at the feedwater regulator valve inlet.

2. To operate the group of pumps automatically at minimum power consumption for various steaming rates of the boilers.

(Continued on page 99)

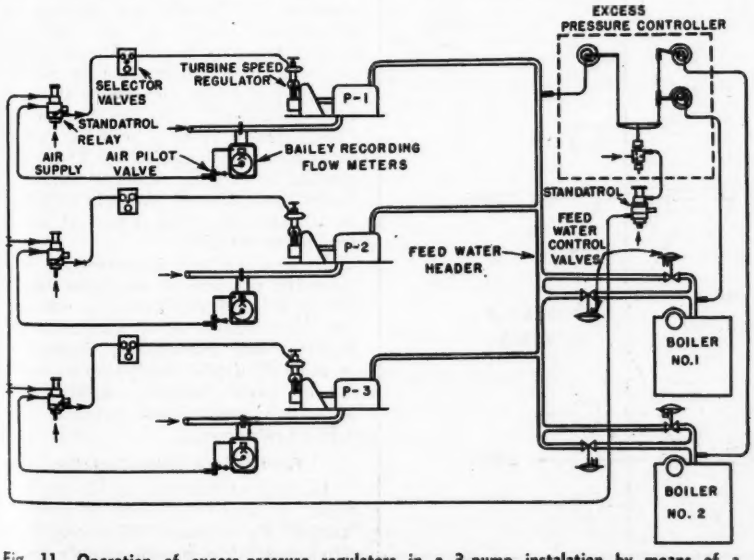


Fig. 11. Operation of excess-pressure regulators in a 3-pump instalation by means of a master pump control (Courtesy Bailey Meter Co.)

What the Power Engineer Should Know About

Series Capacitor Installations

By W. C. Bloomquist

Industrial Engineering Division
General Electric Company, Schenectady, N. Y.

SERIES CAPACITORS have been used to a considerable extent by utilities and to some extent on industrial power systems in connection with welder applications. Many of the utility installations have been directly related to industrial applications where flicker problems or voltage dips associated with motor starting are involved.

It is the purpose of this article to familiarize the reader with the series capacitor — its functions, applications, and limitations, the operating benefits obtained, and to describe briefly the protective control equipment required. It is a tool, and like any tool must be used intelligently.

The intelligent application of a series capacitor in system design offers the operating benefits of a "stiff" system. Such a system may be defined as one having a high short-circuit kva level, or, in other words, a low-voltage drop when subjected to a heavy load. The economics of a series capacitor are dependent upon the specific application and are attractive when alternative means of obtaining a "stiff" system would require more or larger transformers and larger switching equipment. An example of such a comparison is included in this article.

What Is a Series Capacitor?

The term, "Series Capacitor," is an abbreviation and is the engineer's terminology for a *series connected* capacitor. Similarly, when we speak of a "shunt capacitor," a *shunt connected* capacitor is meant. It is the type of connection and not the type of capacitor which is implied. The two types of connection are shown in Fig. 1.

Although the difference between the shunt and series capacitor is the manner in which they are connected in the circuit, they perform different functions. The shunt capacitor is simply a capacitive reactance in shunt with the load or system, and is fundamentally a power factor improver. The benefits of improved voltage level, released system capacity, reduced system losses, and reduction in the power bill, all stem from the improvement in power factor. Shunt capacitors do not improve voltage regulation caused by load changes, but they do increase the normal voltage level.

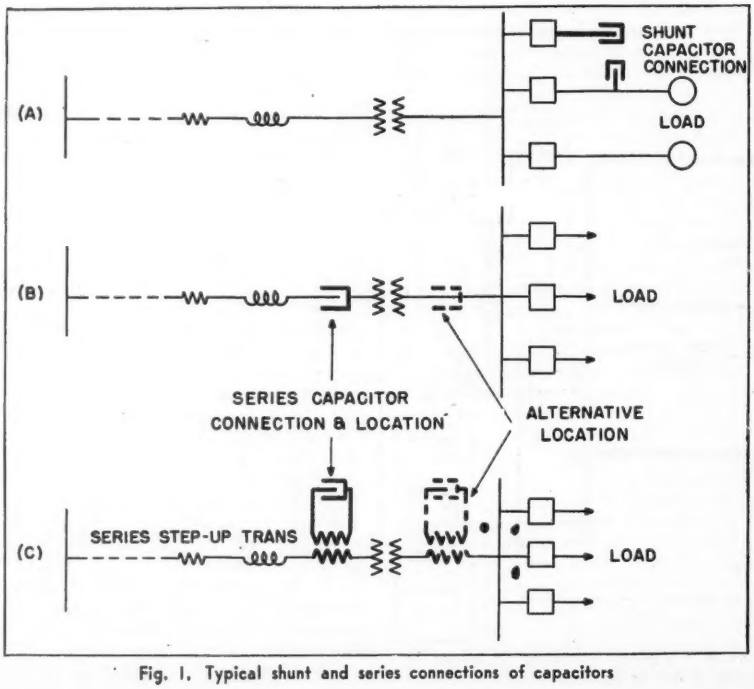


Fig. 1. Typical shunt and series connections of capacitors

A series capacitor may be considered as a negative (capacitive) reactance in series with the line. The voltage rise across the capacitor is a function of the circuit current and this voltage change is automatic and instantaneous; the series capacitor may therefore be thought of as a voltage regulator.

The series capacitor is used as an automatic voltage regulator in contrast with the shunt capacitor which is used fundamentally for power factor improvement.

A series capacitor at rated load provides power factor improvement to the same degree as does the same kva of capacitors connected in shunt. The series capacitor does this by providing an out-of-phase component of voltage in contrast to the shunt capacitor, which accomplishes the power factor improvement by an out-of-phase component of current. The vector diagrams in Fig. 2 show this. In the series capacitor application for power circuits not enough capacitor kva is normally used to change the power factor significantly.

A good test for a series capacitor application is: "Would the problem be satisfactorily solved by an induction or step regulator that could automatically and almost instantaneously assume its new position as dictated by the new load condition?" If the answer is "Yes," then it is very probable that a series capacitor is applicable. (The time constant of voltage recovery following sudden application of load is in the order of 0.01 seconds or less in normal industrial power circuits.)

Because of the instantaneous and automatic response of the series capacitor, it is admirably suited to compensate for voltage drop or fluctuation associated with intermittent, fluctuating, or suddenly applied load, such as welding or motor starting conditions, or fluctuating motor loads, such as saw mills or rubber mills.

Function of a Series Capacitor

In most industrial power applications, the series capacitor is used to "stiffen" the system. Therefore, if a series capacitor is thought of as a negative reactance to neutralize the system

For Industrial Power Systems

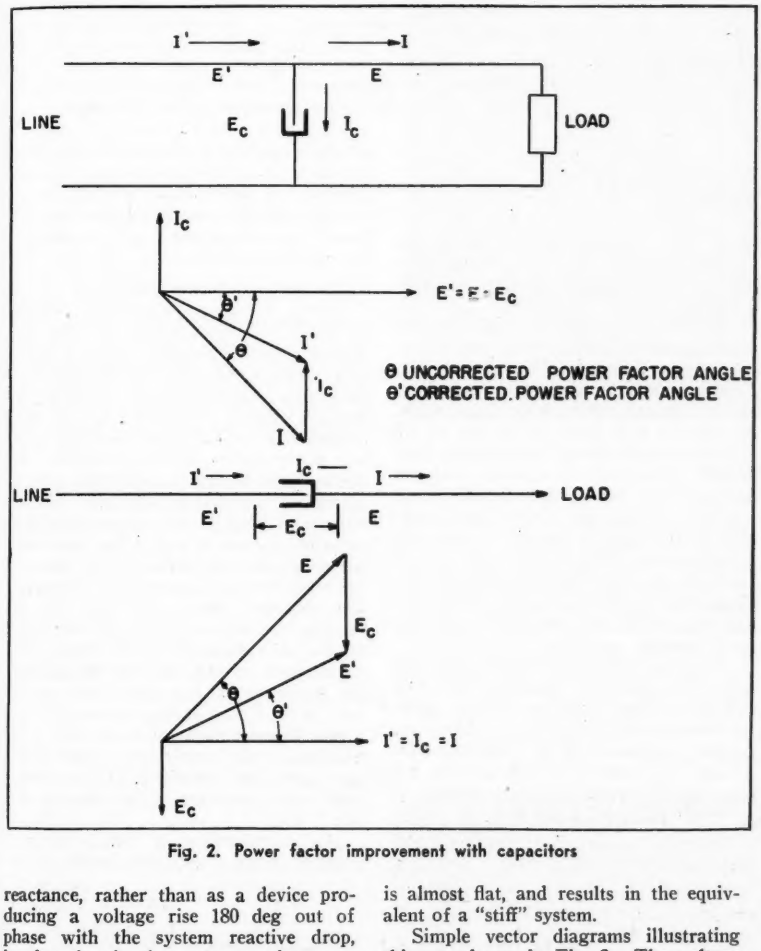


Fig. 2. Power factor improvement with capacitors

reactance, rather than as a device producing a voltage rise 180 deg out of phase with the system reactive drop, its function in the system performance may be more readily understood. The fact that the series capacitor accomplishes its purpose by means of an out-of-phase voltage component is not necessarily important in understanding its function.

We are all familiar with the voltage dip associated with starting a large motor from a "weak" system. The voltage dip — system regulation — can be reduced by means of a reduced voltage starter, larger transformer bank, or by reducing the system impedance. A series capacitor reduces the system impedance since it neutralizes the system reactance.

In typical industrial power distribution systems with cable feeders, the major impedance is the transformer reactance. Since the system resistance is small, usually only a few per cent, the regulation, if a series capacitor is used, is almost flat, and results in the equivalent of a "stiff" system.

Simple vector diagrams illustrating this are shown in Fig. 3. The voltage regulation for a system without a series capacitor is large, as indicated by the relative lengths of the voltage vectors E_R and E_S. With the introduction of a series capacitor of $X_C = X_S$, the capacitor completely neutralizes the system reactance and the regulation is reduced considerably, as indicated by vector E_{S1}. This may be improved even further by over-compensation as indicated by E_{S2}, which is the case for zero regulation.

The series capacitor does not increase the interrupting duty of the system because of the control scheme associated with the series capacitor protective equipment.

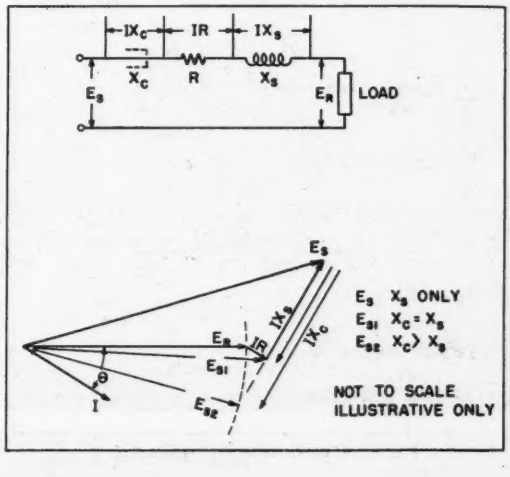


Fig. 3. Improvement in system regulation with series capacitors

Protective Control Equipment

A typical protective control scheme is shown in Fig. 4.

Since the voltage across the series capacitor is a function of the circuit current, the voltage may be high and dangerous to the capacitor dielectric under severe overload or short-circuit conditions unless suitable protective measures are taken. The operation of the protective equipment under fault conditions follows.

At about twice normal current (twice rated voltage across the capacitor), the gap flashes over and automatically short circuits the capacitor, thereby limiting the fault current to that corresponding to the normal circuit impedance. The gap flashes over in a matter of microseconds or long before the current reaches its maximum value. The gap is relieved of continuous operation by means of a short-circuiting contactor M.

The contactor has a shunt and series coil on the same core; the shunt winding M_{SH} functions to close the contactor, and the series winding M_S holds it closed. By means of a small loading resistor, DR, across the shunt coil, a current will circulate causing the flux

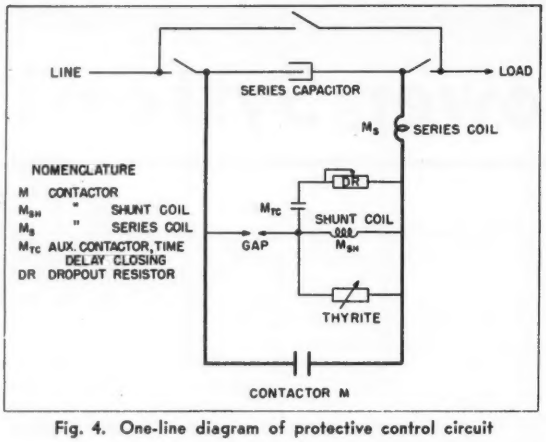


Fig. 4. One-line diagram of protective control circuit

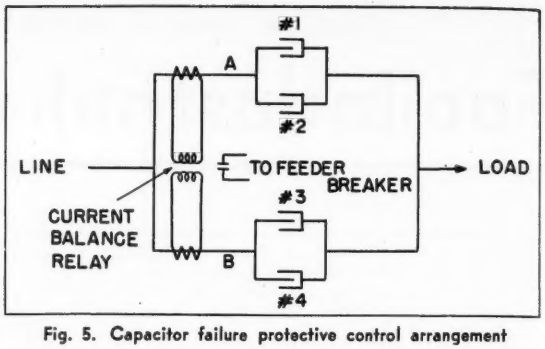


Fig. 5. Capacitor failure protective control arrangement

to buck that of the series winding. With this feature we have a control means for automatically reinserting the capacitor in the circuit when the fault or overload current decreases to a predetermined value, usually about full load. The auxiliary contact, M_{TC}, is closed after a short time delay to prevent a pumping action of the main contactor when closing. The thyrite serves to limit the voltage across the shunt coil by by-passing some of the circuit current.

A capacitor is an extremely reliable device and, since a series capacitor failure is a rare occurrence, it is not common practice to have capacitor failure equipment except on large and important installations. When such equipment is used, it functions to short circuit the series capacitor or to trip the feeder breaker. The latter control scheme is shown in Fig. 5 and, since this is a current balance arrangement, the relay can be set for very sensitive operation. In this arrangement two groups of capacitors, of equal rating and number, are connected in parallel. Each branch or group may in turn consist of several capacitors in parallel. Since the two branches, A and B, are electrically equal, the line current normally divides equally between the two branches.

When a series capacitor fails, it fails by short circuit, and its short circuit impedance is very low. If, for example, capacitor No. 1 should fail and short circuit, branch "A" would have practically zero impedance and nearly all of the line current would flow through that branch. The resulting current unbalance between branches A and B will cause the relay to operate. Since the operation of the relay is dependent upon the unbalance or difference in the branch currents, its operation is practically independent of the magnitude of the line current, and it can therefore be set for very sensitive operation.

The protective equipment and the capacitors are not insulated for line voltage as that would necessitate large and uneconomical equipment. They are located adjacent on a common rack which is mounted on pedestal-type insulators of the proper voltage level.

Series Capacitor Rating

A series capacitor is rated on the basis of ohms and current. The size of the capacitor will depend upon the normal or maximum short-time current. Generally, in applications involving motor starting, it is the total load at the time of motor starting which determines the capacitor size.

Series Capacitor Limitations

There are some limitations which should not be overlooked. If the capacitor is on the primary side of a step-down transformer, and the voltage rise across the capacitor is high, the primary winding may be overheated due to the contribution of increased exciting current at the higher voltage. Such a condition would be aggravated if the power system is unregulated and the system voltage is high at the same time the capacitor voltage is high. The capacitor could be located on the secondary side of the transformer to avoid this difficulty. The voltage across the capacitor is usually 5-10 per cent of the circuit line-to-neutral voltage at rated load. In some cases where the voltage across the capacitor is low, 100-600v, as it may be for circuit voltages below 6900 v, it may be more economical to use a series step-up transformer with higher voltage units, e.g. standard 2400-v units. Such an arrangement is shown in Fig. 1(c).

An examination of the total impedance of the circuit will quickly show

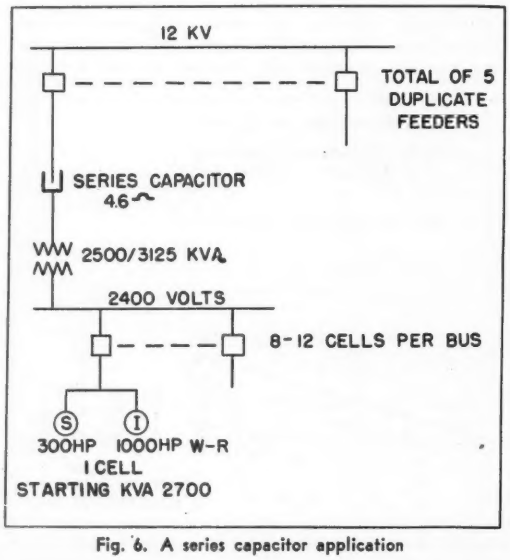


Fig. 6. A series capacitor application

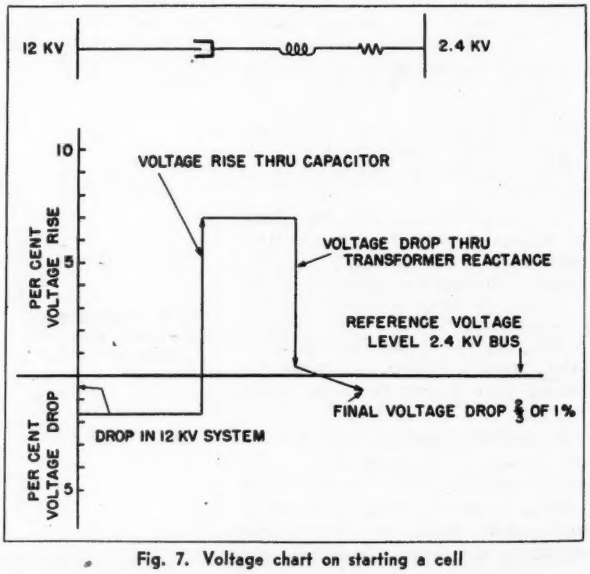


Fig. 7. Voltage chart on starting a cell

that, if the resistance of the system is large with respect to the inductive reactance, the circuit impedance cannot be greatly reduced by the addition of a series capacitor. It is important, therefore, that the ratio of reactance to resistance be large if the series capacitor is to be effective in making an improvement in voltage conditions. This ratio of X/R should be greater than 1 if the series capacitor is to be really effective on general circuits.

There are regions of unsatisfactory operation of motors and series capacitors because of self-excitation resulting in a motor locking in step at partial speed, or vibrating excessively. A synchronous motor at rated speed may hunt. However, in the usual series capacitor application, we are safely outside of this critical range. These regions of self-excitation and hunting are fairly well established, so misapplications are avoided. Generally, if the capacitor reactance is less than the motor transient reactance when referred to a common base, no trouble will be experienced. In those power systems having very little resistance it may be necessary to connect a resistor in shunt with the capacitor for satisfactory operation of motors during starting.

An Ideal Series Capacitor Application

The following description of one application will serve to illustrate the benefits obtained with a series capacitor for a case where the voltage regulation requirements were stringent.

The series capacitor was the only practical solution at this time, and the cost for five equipments was $45,000 compared with $125,000 to $200,000 for alternative methods, which would not be entirely satisfactory.

This large airplane-engine manufacturer has a battery of forty-two "cells" for production testing of his engines. Each cell consists of an induction generator of the wound-rotor type, driven by an engine, and a 300-hp synchronous motor driving a compressor which furnishes the air requirements for the engine. These forty-two cells are fed from transformer stations as shown in Fig. 6.

Since the induction generator load torque is regulated by an adjustable resistor in the generator rotor circuit, part of the engine output is recovered and the power delivered to the system. The remainder is dissipated in the resistors as a slip loss proportional to the engine speed above normal synchronous generator speed.

Since the generator loading torque varies as the square of the bus voltage, a voltage drop will cause the generator to unload, and with a fixed throttle on the engine the speed will increase. A change in bus voltage level is not objectionable since the loading can be compensated by adjustment of the resistor. It is the abrupt voltage dip caused by starting other large motors on the same bus which is objectionable. When the two motors associated with one cell are started, the voltage drop on the 2400-v bus is excessive, about 7 per cent as observed at the switchboard instruments, causing the other induction generators on that bus to unload and their engines to overspeed. The voltage drop on the main 12-kv power system is 1.5 to 2 per cent. The maximum drop that can be tolerated on the 2400-v bus is 2 per cent.

Fig. 8. Series capacitor equipment with doors open to show switch handles and protective panels

Any conventional means of motor starting could not be used unless the transformer impedance could be zero. A synchronous condenser for each bus was considered but would have required replacement of the present 2400-v switching equipment.

The series capacitor selector compensates for the transformer reactance and a portion of 12-kv system reactance so, the only voltage drop is that due to the system resistance which is less than 1 per cent. Fig. 7 shows the voltage chart on starting a cell.

There is a further benefit from the series capacitor. The voltage regulation under normal load changes will be extremely small so, very little if any adjustment of loading resistors will be required for load changes associated with normal testing procedure.

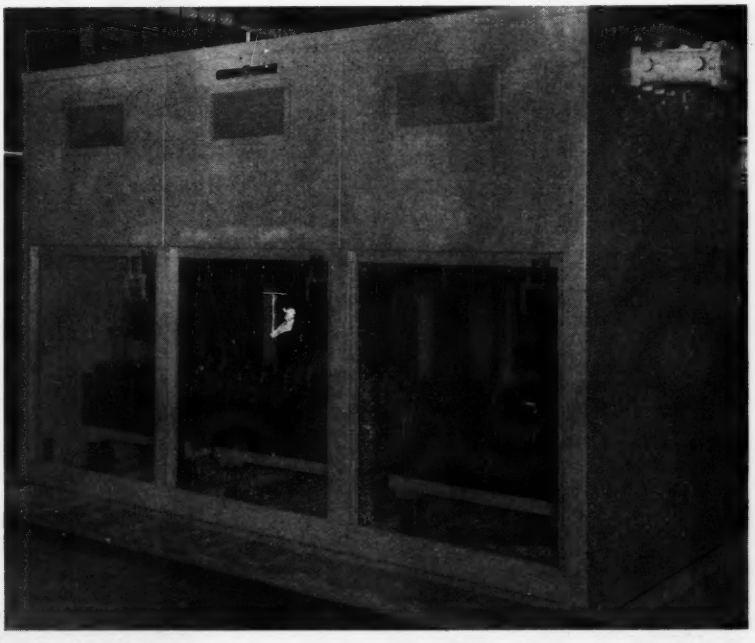


Fig. 9. Series capacitor equipment with rear panels removed to show capacitor units and rear of protective panels

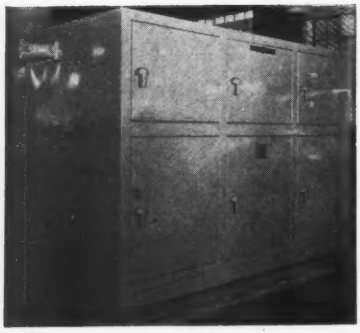


Fig. 10. Oblique front view of series capacitor equipment rated, 3-phase, 60 cycles, 540 kva, 910 v, 198 amp

The equipment is of unit construction, totally metal enclosed, with key interlocking for safety. The isolating and by-pass switches are group operated. The protective control scheme is similar to that shown in Figs. 2 and 3. The switching is arranged so the feeder circuit breaker does not have to be de-energized to inspect or service the protective equipment or capacitors. Figs. 8, 9, and 10 illustrate front open, rear, and front closed views, respectively, of this unit equipment as delivered ready for installation.

U. S. Boilers Inadequate

CALLING FOR A rebirth of technical and economic thought in the field of steam generation at an ASME meeting in New York City on February 6, J. E. Tobey said: "Barely 10 per cent of the power plants of the nation burn a wide range of coals with a high degree of satisfaction and efficiency. The boiler plants of America, which are virtually the heart of its industrial system, on the whole are not good. Surveys made from the coal burning standpoint involving several thousand boiler plants, and many fuel conferences for the better utilization of coal, attended by hundreds of industrial consumers, have yielded unmistakable proof that most plants are obsolete and that insufficient knowledge of vital fuel and combustion factors is reflected in their original design."

Mr. Tobey divided the power and larger heating plants of the country roughly grouped, fuel-wise, into three categories: 10 per cent at the top, which function with high efficiency, 50 per cent which do not burn any type of coal satisfactorily and with good efficiency, and 40 per cent which burn a very restricted range of coals with varying degrees of satisfaction and efficiency. Part of the reason for this great inefficiency, Mr. Tobey said, was because the plants were not designed, but the component elements simply purchased from different sources and erected. Among the other factors are lack of fundamental information on coals and their availability, keeping down costs, wrong selection of equipment, destructive competitive bidding, divided responsibility, improper co-ordination of boiler, furnace and stoker or pulverizer; excessive overloading; and ash fusion temperature.

Transformers Chemically Cleaned

Sludge accumulation in oil cooling system of transformers is a cause of temperature rise in coils . . . Forced circulation of oil sometimes used as cleaning method . . . Latest method employs alkaline liquid capable of emulsifying heavy oil sludge

By Vincent E. Bowes
Oakite Technical Service Dept.

OF ALL the machinery and apparatus used in modern industry, the oil-immersed, self-cooled transformer probably comes closer to perfection than any other equipment. A transformer can be installed in a power station or in the network in remote outlying districts and may operate satisfactorily for many years with little or no attention. Because transformers are capable of giving trouble-free performance over long periods there is a natural tendency to neglect carrying out the maintenance precautions necessary to safe operation.

It is well known that the oil in breather-type transformers has a tendency to oxidize or sludge over a period of operation. This sludge deposits on the interior of the cooling tubes and on the walls of the transformer case greatly reducing heat transfer. The result is that the operating temperature of the transformer increases. In some cases this sludging condition is not serious and although the temperature does rise, the increase is not enough seriously to affect performance. The tubes may be cleaned at infrequent intervals or when the transformer is taken into the repair shop for overhaul prior to being placed in a new location.

In a great many instances, however, oil sludging causes an excessive rise in temperature and in these cases the best procedure is to take the transformer to the repair shop for a thorough cleaning. Under today's conditions particular attention is being paid to oil cooled transformers since many are operating at peak loads over prolonged periods of time. Sludge deposits in transformers in heavy service can cause serious difficulties for if the the transformer is allowed to operate at excessive temperatures which result from poor heat transfer, coil insulation may rapidly lose its mechanical and electrical properties. This causes even heavier sludging and still poorer cooling. In severe cases a short circuit may result. Transformer explosions and fires have not been uncommon and the thought has been ad-

Fig. 1. In cleaning procedure, hoses are inserted in two openings and hot cleaning solution runs through them under pressure. Complete cleaning job assures maximum heat transfer when the transformer is back in service

Fig. 2. Cleaning solution is heated in this portable tank by means of a kerosene immersion burner. Centrifugal pump delivers solution to transformer. Pump in background returns solution to supply tank where it is reheated and recirculated

vanced that these accidents may be caused by failure of the cooling system, due to sludge deposits.

The present practice in some plants is to clean the tubes by circulating transformer oil through them under pressure. Although this does a fairly satisfactory job it its expensive and it is far from the ideal solution. Circulation of oil under pressure undoubtedly clears the tubes that are completely blocked but it cannot remove the thick deposits which adhere tenaciously to the tubes and tank surfaces.

As the photographs reproduced here show thorough cleaning can be done with comparatively simple equipment at a minimum of time and manpower. When inspection indicates that a transformer requires cleaning, it is brought into the repair shop, set up on wooden blocks and the top is removed. The windings are lifted part way out of the tank, and suspended in this position. The oil from the transformer is forced through a filtering medium and is pumped over the windings under the pressure to remove loose sludge deposits. After draining, the windings are then taken to another section of the shop where, after further cleaning and wiping, they are inspected and any repairs necessary are made.

The oil remaining in the transformer is drained off and the tubes and tanks are then cleaned. A heavy duty Oakite alkaline material capable of emulsifying and loosening oil sludge deposits is employed. A solution of this material is prepared in a tank heater by a kerosene immersion burner and is delivered to the transformer by means of a centrifugal pump. Two garden-type hoses attached to a Y connection at the pump carry the solution to the top of the transformer. The hoses are inserted in the tube openings and the solution, under pressure, is forced through them, running out at the bottom into the transformer tank. A second pump returns the solution to the supply tank where it is reheated and again circulated.

The transformer shown in the photograph, a 4000 kva model, contains 234 2-in. tubes, a total of almost one-half mile of tubing to clean. Each tube was circulated for 4 min, the operator simply switching the hoses to the next pair of tubes after a 4-min circulation period. At the end of this operation it was apparent that the cleaning solution was very contaminated. How large an amount of sludge had been removed was indicated when a sample bottle of the solution was taken and allowed to settle. The bottom half of the sample was nearly black, with many foreign particles in suspension. The top half consisted of heavy black emulsified oil.

The cleaning solution was therefore dumped, a new solution was made up and circulated through each tube for three minutes. The walls of the transformer tank were easily cleaned by spraying the cleaning solution over them. After rinsing with hot water a piece of white cloth attached to a wire was pulled through a few of the tubes, picked at random. The cloth came out clean without the slightest trace of soil, indicating that the tubes had been restored to new condition.

Previously operators shied away from water solutions to clean oil cooled transformers but removal of all water is really no problem. A hot water rinse permits the tubes to dry down of their own heat, but to make absolutely certain that all moisture has been removed, the transformer is turned upside down on a hair felt mat. A hot air blower is connected through a manhole in the floor and the tank is hot air dried for 8 hr. The tank is then turned right side up and the windings are replaced.

The entire cleaning job on 4000 kva transformers takes approximately 60 man-hours which compares very favorably with the time required by the oil cleaning method. The results obtained are far superior, for the thorough cleaning assures complete restoration of heat transfer and the transformer will give many years of trouble-free operation.

Centrifugal Pump Control

(Continued from page 93)

3. To control the pumps automatically to maintain desired division of load among the pumps with stability.

To carry out these functions, the system may be arranged so that a measurement of the flow through each pump, taken on the suction side, is balanced in the pump regulator by a master loading pressure derived from the excess pressure that is to be maintained. Variations in this excess pressure will then cause the pump regulators to adjust the pump speed, and as a result, the pump flow, to hold the excess pressure at the required value.

A typical installation involving three turbine-driven pumps and a master excess-pressure controller is shown on Fig. 11. The individual turbine speed regulators are provided with air loading pressure through relay air valves. The loading pressure itself is determined by the excess-pressure controller which consists of separate pressure Bourdon tubes with linkage, registering the pressure differential across the feedwater regulator valve and maintaining this differential at a constant value.

Such master pump controls are used very widely and it would prove difficult to provide an illustration of every possible combination** involving their application. It is sufficient, however, to realize that their arrangement is extremely flexible and that, once the problem of the control function desired is thoroughly understood, the control manufacturer is generally in a position to recommend the most suitable master control application.

While the control of centrifugal boiler feed pumps cannot be termed as typical of every kind of pump control which may be encountered, certain similarities will be encountered in most cases. Therefore an understanding of what may be accomplished in this particular field of application will prove helpful in solving most pump control problems. The controls described above, however, are basically corrective controls. Protective controls introduce certain problems and features which differentiate them considerably from corrective controls, hence a description of a few typical protective controls will form the subject matter of the next article.

**It is hoped that some of these can be shown and discussed in a subsequent article.

IT HITS LIKE A BOMB — In the early hours of World War II, the British found that even their most powerful battleships were paralyzed by near misses. The electrical power systems were completely knocked out, due to damaged control. An exclusive Westinghouse design is a shock machine for testing circuit breakers, which led to the manufacture of new breakers that would not trip even under full load as a result of shock impact.

When Flow Meters Err Check Installation

Fundamental principles of orifice flow meters—Tap locations specified—Installation precautions—Piping defects that cause erroneous readings—Major rules for instrument attendants

By Louis Gess*

ACCURACY of flow measurement depends to a large degree on correct installation and a reasonable amount of maintenance. Serious flow meter installation and maintenance troubles are often due to incomplete recognition of these two important factors. In turn, uniformity of product, speed of production and economy of operation are almost wholly dependent upon accuracy of measurement.

The troubles which develop in a flow meter installation may occur in the various components, such as the primary measuring device, piping connections to condensers, the condensers or their equivalents, the piping to the meter body and the meter body.

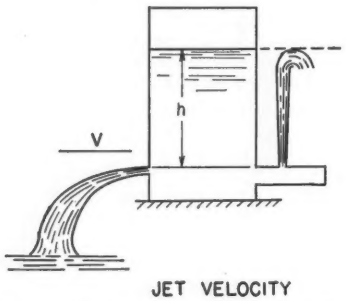


Fig. 1. Illustrating principle of falling bodies

First, basic flow meter equation follows the law of falling bodies: $V = \sqrt{2gh}$ where V = velocity in ft/sec; g = gravitational force; h = head in feet. This is illustrated in Fig. 1.

Flow meters considered here operate on a differential head across a restriction in a closed tube in which a fluid flows. They are known as "head meters" to distinguish them from weighing, volumetric, current, area, etc. Differential heads may be produced by such devices as the thin plate orifice, flow nozzle, venturi tube, pitot tube, etc.

Three well known types of orifices, concentric, eccentric and segmental, are shown by Fig. 2. The concentric type is installed with center of opening concentric with the center of the pipe. In the eccentric type, the opening is approximately 0.10 in. above the bottom of the pipe.

The most commonly used orifice is the concentric type. The eccentric type throws the vena contracta (lowest pressure) position further downstream than the concentric. It is frequently used with high hub flanges. The segmental type is largely used for measuring fluids carrying solids in suspension.

Figure 3 indicates behavior of the line and differential pressures in the proximity of the orifice. Movement of fluid passing through the orifice causes a decrease in line pressure and this reaches a maximum value approximately one-half pipe diameter downstream from the upstream face of the orifice. Proceeding downstream, the line pressure is

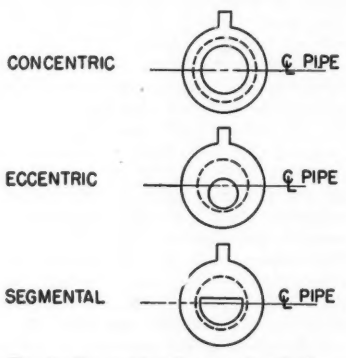


Fig. 2. Types of orifices used with flow meters

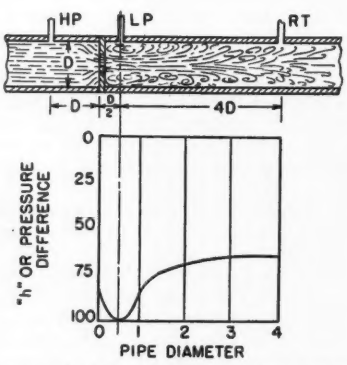


Fig. 3. Fluid flow with a thin plate orifice

slowly restored until, at the restoration point, 4 pipe diameters from the face of the orifice, it has reached its original value less the permanent pressure loss.

Figure 3 also illustrates why the downstream tap must be carefully located. The orifice is designed for a 100 per cent value of h, and this is obtained only when the downstream tap is located at the correct point. If the tap is located either upstream or downstream of the correct position, the differential pressure will be less than the true value and the meter will read low. A tolerance of ½ in. is permissible on location of vena contracta taps and 1 in. on pipe taps. Corrections can be made for variations of the correct tapping distance, if the correction does not not exceed 1 per cent.

There are several additional kinds of taps, only two of which have widespread use. These two are flange taps, where both are located in the orifice flange, 1 in. distant from the upstream face of the orifice, and pipe taps with the upstream 2½ pipe diameters above, and the downstream 8 pipe diameters below the orifice.

If the low pressure tap is moved back toward the orifice plate, differential pressure would be less for the same flow than if measured at the vena contracta position. Therefore, a multiplying factor greater than 1 would be required should flange taps be used when the orifice had been designed for use with vena contracta taps.

With pipe taps, the low pressure tap is located 8 pipe diameters downstream from the face of the orifice plate. The differential pressure is the sum of the permanent pressure loss plus a small amount of pipe friction and for a given flow would be considerably less than that for either the flange or vena contracta taps. In other words, a considerably greater flow can be measured with the same differential and orifice ratio than with the other taps. This increase varies from 10 to 40 per cent, depending on the orifice ratio.

Pipe taps are useful in two ways. Larger flow can be measured without exceeding the maximum allowable orifice ratio, and when permanent pressure loss is a factor it can be decreased by using a larger orifice ratio and a smaller differential pressure.

Permanent pressure loss is caused by friction. As shown by Fig. 4, pressure loss varies from about 90 per cent for a d/D value of 0.25 to 60 per cent for a d/D value of 0.60 and decreases to about 20 per cent for a d/D value of 0.90.

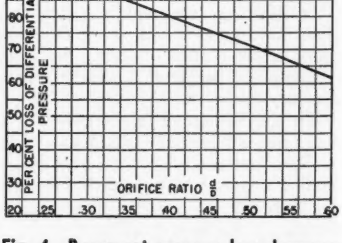


Fig. 4. Permanent pressure loss decreases with increasing orifice ratio d/D.

In using a curve of this type to determine permanent pressure loss, the average operating differential should be used instead of the meter's full scale value. For example, if a 100 in. meter is normally operating at 70 per cent flow of full scale, the differential is only 50 in. of water and the permanent pressure loss for a d/D ratio of 0.50 is 35 in. H_2O.

(Continued on page 126)

*Flow Meter Engineer, The Brown Instrument Co. Division of Minneapolis-Honeywell Regulator Co.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

☆

FUSES VS CIRCUIT BREAKERS ON 440 V CIRCUITS

The very large fault currents of 50,000 to 100,000 amp or more, that flow when a 440 v. power system of large extent is short circuited, require high-speed interruption to protect motor starters from short-circuit damage. Since the impedance itself inherent in a 10-hp motor starter reduces the fault current from 50,000 amp available to only 10,000 amp, properly chosen fuses built into starters can have adequate interrupting capacity, even on large systems. The fuse starts to melt in the early part of the first cycle of fault current, introducing resistance and normally opening the circuit in 30 or so electrical degrees, whereas a circuit breaker cannot interrupt the current until the end of the first half cycle, or 180 deg. As this current limiting action reduces the heat energy that can pass through a fuse rated 100 amp or less to a fraction of the energy passed by a circuit breaker of similar size, the right type of fuse will give better protection than a circuit breaker, for motor starters of less than 50 hp.

—G. E. Rev.

☆

CONTENTS

The Chief—"He Don't Know Nothin' About Engines **102**
By R. L. Brown

Practical Hints and Kinks **105**
Ventilating Water Tank During Painting
Reinforcing Flanged Fittings
Manifold Eliminates Trouble from Freeze-ps
Tool for Replacing Lamp Bulbs
Wire Sleeving Substitute

The Boiler Fireman's Handbook **106**
By J. R. Darnell

The Danger of Obsolescence **108**

Replacing a Bucket in an Hydraulic Turbine Runner **109**
By Frank I. Morgan

How Would You Do It? **110**
Problem 38. Staggering the Operation of Electric Welders

Questions and Answers **116**
Help Wanted on Lubrication and Inspection Schedules
What Do You Do About Boiler Feed Pump Corrosion?
How Divide Load Between Two Synchronous Converters?
How Fill Cracks in Concrete Chimney?
Should He Install Motor Drive or Direct Turbine Drive?
Why Is Water Level Hard to Control?

Chart Showing the Correlation of Free CO_2, pH and Alkalinites **124**

A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

The Chief—"He Don't Know Nothin' About Engines"

That's what the manager of this planing mill told the engineer so he proceeded to run the power plant according to his own cockeyed notions. The Chief, poor devil, needed the job and had no alternative but to follow instructions. Follow them, he did—to his grave—while two unfortunate operators met an untimely end during the process. Read this tale of woe, this eloquent dissertation by Mr. Brown, on how not to run a power plant and ask yourself, what are we fighting for? Is this free enterprise, or what?

By R. L. BROWN

MY PURPOSE, in writing this article, is to explain about some of the troubles we had at a certain small power plant where I was employed as assistant to the chief. They may be of some interest to other operators having had similar experiences.

These things happened about ten years ago, but I haven't forgotten any of the gruesome details. To begin with, the particular engine that was used as a prime mover for the planing mill and box factory was too light for the load, but it was futile to attempt to convince the management that this engine was too small. The manager merely informed the Chief that, "he don't know nothin' about engines." Why didn't he do something about the mechanical parts of the engine, set the valves or something?

This box factory and planing mill at one time was just a planing mill. That was before the depression. It was powered by a slide valve 14 by 24 in., 150 rpm Atlas engine and at that time the old company that owned the plant got along pretty fair because their manager was a power engineer himself and it was always his policy never to load the engine beyond its capacity to run up to full speed, even if it meant shutting down one of the planers. This program had been followed for several years with success. As some of the readers of POWER PLANT ENGINEERING probably know, if a planer is allowed to lose its rated speed, the lumber comes out at the other end looking like a washboard or it has a burned spot on the board where the feed was stopped to allow the shavings to be cleaned out of the blow pipe. This kind of lumber never sells very well. Who wants to pay top price for a third class manufactured product?

This condition is not so important in the case of common and box grade of lumber, but it cannot be tolerated when it comes to the selects and drain board stock. Therefore, in order to make the most money per thousand out of their manufactured product, the management must have that product manufactured up to standard or lose money. I wonder why some of these managers are so blind, that they cannot see that they are throwing away the company's money by limping along on pony power, when what they need is a good size team of draft horses. Perhaps it is us steam engineers' fault—maybe we don't present our facts to them in the right manner.

Until the time the new management took over there was no box factory at this mill. They could not justify spending the money to build one, but maybe the manager knew more than some of the people gave him credit for. He said that "the whole plant would suffer in its operation if more load was added and a '40 thousand' factory will crowd 250 bhp pretty close, especially if it is belt driven with its numerous line shafts, counter shafts, etc."

They Install a Box Factory

When the new management took over, the first thing they did was to agitate the building of a box factory and the manager tried to convince them that they would have to install more boiler power at their saw mill power house, to no effect, however, and it wasn't long before there was a new general manager on the job.

This fellow was young with lots of big ideas and very little experience to back any of these ideas up.

Shortly after this, about a month if I remember right, the writer went to work as an assistant to the chief. If I had known about some of the troubles in store I would have drifted on, but those days a job was a job, even if it didn't pay more than 47½ cents per hr. Some of the readers of POWER PLANT ENGINEERING may remember those days when the stacks in a good many power plants had rust on them.

The new company decided to get busy as they wanted to be making boxes. They didn't build a regular size factory, but decided to use the dry storage shed and convert that into one.

If I list some of the machinery installed the picture will be a little more clear. There was one 50 hp fan, one 8 in. Mitts & Morril hog, five cutoff saws, one cleat machine, one printer, two single resaws, one double resaw, one rip saw, one stapler, a pony planer, and one trim saw. This machinery was added to the already heavy load on the 14 by 24 in. Atlas engine.

The old planer mill already had one 30 in. Ross surfacer, one Yates 20 in. matcher, one 145 hp fan, one rip saw and two trim saws. The results, with all of this load attached, were something a person observes, only about once in a life time. The machines all moved but not very fast.

The new manager pulled his hair and cussed plenty. He threatened to fire the chief engineer. The manager wanted to know why in tarnation the engine didn't get up to speed. Well, the chief finally convinced him that there was far too much load hitched to that little Atlas. But that didn't stop the manager. He went on trying to run anyway.

It wasn't long until that engine wasn't long for the world. The drive shaft just naturally broke in the middle and this put the whole works on "the fritz" until a new engine could be obtained.

After a week or so of scouting around, the manager located an old Reynolds Reliance Corliss 18 by 30 in.—120 rpm. The joker here was that the manager would not listen to what the chief told him.

The chief suggested that an inventory be taken of the required horsepower for all the machines after allowing for friction loss, then an engine of proper size be bought, but this was not the rule followed in this case. The engine bought was one that was guessed to be large enough, disregarding its mechanical condition.

The day that the engine arrived via motor truck, the chief and I were instructed to take off the cylinder head and remove the piston, also to remove the valves. This we did after much difficulty as, evidently, the engine had been setting outside somewhere in the weather as the studs were pretty rusty. We twisted some of them off in the process of removing the piston and the valves. This engine was in a bad way from a mechanical standpoint. The cylinder was badly grooved and the valves and their seats were cut from wire drawing.

Repairs Not Needed

The chief balked against accepting the engine. He said "that it wouldn't operate satisfactorily until it had been overhauled in a machine shop and until a number of things could be taken care of such as reboring the cylinder, making a new piston and rings, reboring the valve seats and having new valves made, but the manager told him that he was all wet as he had seen engines in worse condition than this down South and they had worked O.K. Anyway, what was he paying the chief and me for? We could get some emery cloth and a file and polish up the rough spots. Maybe this manager never heard or thought about what the steam would do when it hit those grooves in the valves, seats and the cylinder walls. Maybe he thought that this leakage of steam would stop the engine from pounding when it hit the centers, which of course it did not do.

After getting the manager's O. K., the truck man, the chief and myself and several other men began our job of unloading this engine and installing it and this isn't any boy's job when you have to do all of the heavy work with jack screws, pinch bars and cribbing made of railroad ties.

As soon as the engine was off the truck, the chief and I had to make a wood template showing the location of the foundation bolts so that the form could be made for a concrete foundation.

This is a job that cannot be done in too much of a hurry if one would have the outboard bearing of the engine at 90 deg from the center line of the engine cylinder.

The chief first made a template of the main frame by measuring lengthwise and crosswise. He then laid this out on the factory floor and proceeded to measure the crank line center with a scriber on the floor. After getting it quite close as to length of the shaft, he then made another template of 1 x 6 in. lumber for the outboard bearing, and nailed this to the one for the main frame.

Some of the readers may wonder why a blueprint wasn't obtained from the Allis-Chalmers factory. The manager's idea was to rush everything to completion so as to get the factory in operation, regardless of the mistakes that might be made and as the chief and I were only working for him we were not in a position to dictate. We could only make suggestions which didn't seem to meet with much success. Some of you who read this may have found yourself in just such a predicament. You may say that we should have quit. We thought of that but jobs weren't too plentiful in 1934.

Not having any blueprint we could not put much of an argument in regards to the proper depth of the foundation. So this was done by contract, by guess and by Old Hickory. The main block of concrete had enough concrete, as far as volume was concerned, but not as to quality. The mixture was in the neighborhood of 8 to one. The excavation was about two feet deep and I don't remember anything but mud in the bottom of that hole. This work was done in the spring of the year and it rained a lot there at 4500 ft elevation. Finally this concrete job was completed but they never tied the outboard bearing pedestal to the main block, it just sat there like a marker for a grave, which this engine finally dug for two men.

The work of moving the engine up to and on the foundation was uneventful and after about two weeks we had it ready for the grouting. The management would not permit the chief and me to remetal the main and quarter bearings at that time as they were in too much of a hurry to get that old pile of cast-iron moving. Move, it did; it moved up and down, sideways, and around, but not too fast in the clockwise direction since this was the way the engine operated. It is a wonder that the manager did not have it installed to run under instead of over. Maybe he didn't think of it.

There sure was a lot of disappointment the morning this engine made its trial run. The management was certain that it was going to just run away with the load. But this did not happen. It was a long while that morning before we coaxed the old girl up to speed but that was not until the manager ordered the chief to lengthen the cut off. This, the chief did after much argument. It seems that the manager didn't know there was such a thing as a safety cam. He seemed to think that the only thing necessary was to get that engine moving along at about 100 rpm so that the boxes could be made. In a way he was right, but it seemed as though he was putting the cart before the horse. When the cutoff was lengthened so that the valves would not be unhooked the safety cams had to be slipped around so that they were useless as far as stopping the engine was concerned, if the main belt should come off the flywheel or the governor drive belt should break.

This was not the end of our troubles, as the fireman over at the power house wanted to know what in Hail Columbia was happening to his steam and the water in the glass. It seemed that every time they tried to operate the planing mill and the box factory together with all machines on, it pulled water out of the boilers along with the steam.

As stated before, this engine was an 18 by 30 in., 120 rpm unit; therefore it required a 6 in. steam pipe for its supply. Such was not the case.

The old Atlas had been supplied with a 4-in. line part of the way and a 5-in. line the rest of the way, the 5-in. line being nearest the boiler room power house. This entire steam line was 350 ft long and bare of insulation its entire length.

The chief tried to explain at that time, that if a covering at least an inch thick was installed on the long steam pipe, it would help matters along, but the manager decided that after paying $500 for the Corliss and another $250 in installing it, he had spent enough money. What he wanted then was results. Well, he got results, but not the kind he hoped for.

There was one headache after another for him. The firemen quit, one after another, and the chief had to get along with green men, and you fellows that are in charge of power know what a green crew is. It was a case of running all departments on low steam, so naturally the production and consequently, the profits, suffered.

This condition dragged along all the summer of that year with hot boxes and bearings on the engines due to the heavy drag at the slower speeds, especially the 18 by 30 in. Corliss at the factory. The outboard bearing pedestal of this machine moved in the ground with every stroke. That made the crank pin as well

"Watch yourself after this, Hemsley. If your hand had gone all the way into that motor, think of the time it would have cost us!"

as the quarter boxes heat. I happen to remember those long days that I put in helping to cool some of those bearings. We had to use steam cylinder oil on all bearings as there was too much pressure on those 4½ in. pins. They would smoke in a very few minutes if any lighter oil was used. We tried the light oil first. We had an oil that was suggested by a Standard Oil engineer but, although this was an excellent oil, it was not suitable for this particular job.

Finally fall of the year came and with it cooler weather, rain and snow. Then we had to shut down time and again to wait for the steam to be raised. Fortunately, the mill operation at that place was was of a seasonal character and when the mill shut down we were able to get along better.

By this time the manager had been convinced that something had to be done or the stockholders would be on his neck. I think that perhaps they were, or he would never have listened to the chief at all.

He bought the Johns-Manville covering that the chief ordered, also a steam separator, a bucket trap, valves for a bypass around the trap, as well as several new traps throughout the plant where there had been bleeders to the atmosphere. This plant was a non-condensing plant throughout. Also enough pipe, return ells and an old boiler were obtained to make an exhaust steam heater. Previously, the heater had been a small capacity, closed type unit on the sawmill engine exhaust. The water rarely reached 125 F.

The chief's idea was to pipe all the obtainable exhaust steam into this homemade heater. We could not use the exhaust from the 18 by 30 in. Allis-Chalmers engine due to its being too far away from the power house, but the shotgun, nigger, loaders, pumps, auxiliary engines and the 22 by 36 in. Allis-Chalmers were piped into this heater, which had 500 ft of 2 in. pipe in it. This heater was also insulated from the atmosphere by using Johns-Manville asbestos blocks. Then a water proofing material put on over the asbestos at this heater had to be set outdoors close to the power house. The results were gratifying as this brought the water temperature up to nearly 200 F.

The chief wanted to have the 18 by 30 in. Allis-Chalmers engine cylinder sent to the machine shop and put in good mechanical shape but the manager again failed to see the point. He also refused to install another 150 hp boiler which the chief felt would help matters along. The manager had what he thought was a better idea. He had the Dutch ovens fitted with 9 ft grates where 6 ft grates had been before and put in two feed openings.

These four 125 hp boilers had been operating, well overloaded. This was another costly mistake on the manager's part. The steam pressure held up for a few days after the mill started the next spring but not for long. All four of these boilers went to leaking at the seams and the flue sheets. It was a hot job rolling those flues and trying to calk up the rivets as this is what the manager wanted done. He figured if we once got them good and tight they would not leak any more.

But they did leak within a couple of days and that was not all. There was a nice blister on No. 1 boiler by then. This was something the chief and I could not handle without advice from the Boiler Inspector, so we balked.

This Inspector made the manager blank out the last 3 ft of his 9 ft grates because he claimed that there was too much blow torch effect from so much grate surface. He also made them cut the induced draft nozzles down. This put the manager right back where he started from with, of course, the expenses of the boiler makers, the new flues and the loss of production due to lack of something, possibly I should say "a good manager."

The plant finally resumed operation after being down for about two weeks. The production went up somewhat from the season before; the fact that the pipes were covered and a good supply of hot water for the boilers helped a great deal.

This shut down, however, had cost us several valuable men, as they were tired of these lay offs and lost time. Sometimes I wonder why the chief and I stuck. I guess that it was because we got along well. I liked the chief because he was fair and seemed to know what he was doing. I guess maybe he liked me, because I always tried to do as he told me and do it willingly.

We had no more serious difficulties with the boilers after that, other than a few tubes to roll but the steam pressure was still a problem. The scale was not bad as the water used was excellent and did not need any softening. However, it did pit the piping somewhat but the chief, finally, had convinced the manager that they would have to do something about these pits. This was one good turn that the manager had done when he took over. He called in a chemical engineer and a formula was prescribed and used.

Came the Fall and More Trouble

We went through the summer on somewhat of a drag. Then came the fall with its cold mornings. The same old thing confronted us—low steam and lost production.

The manager was by then quite worried, about his job mostly. He just could not see the light or perhaps he did but then it was just a little too late. He went back to his home in the sunny South for the winter, little knowing what the winter would bring forth.

As usual the box factory and the planer were quite up to speed when the sawmill was down for the winter. This particular winter however, happened to be pretty severe there in the mountains at 4500 ft elevation. There were days when the steam was low and the machinery being cold turned only with difficulty; frozen lumber is harder to cut than dry lumber.

As already mentioned, his 18 by 30 in. Allis-Chalmers engine would not pull the load with the normal setting of the reach rods, so the manager ordered the cut-off lengthened and in order to do this the chief had to set the safety cams around so far that when the governor was in its lowest position the valves were wide open and could be picked up just the same.

Well, it was on January 7 that the cold wave hit—nearly 30 deg below zero. That morning the plant started but it didn't run long as the main belt, also the governor belt, kept slipping due to the overload and the frost that was on everything. At nine o'clock that morning the main belt came off, knocking the governor belt off with it. The engine immediately began to race as the valves were wide open.

Tragedy

The operating engineer had been outside the engine room doing a repair job. He ran in just in time to get a 500-lb chunk of that 8-ton wheel, right between the eyes. He never knew what hit him. The sawyer was in the engine room getting warm. He also was knocked through the wall but he didn't die just then; it was nearly a year later. Within a few seconds this part of the plant was a wreck, pieces from the flywheel went 200-yd away to bury themselves in the ground. This fateful accident put the factory and planing mill out of business for three months.

At the Coroner's inquest, the accident was found to be caused by the extreme cold weather and no one was held responsible. Sometimes I am glad that I am not a manager and that I have a conscience. Of course this accident brought an end to his career. It was said he quit on account of ill health, but he left anyway.

A new manager took charge within a couple of weeks. He immediately set about for ways and means to cure the trouble we were having. The main frame and some of the parts of the engine were saved. All other parts needed were ordered from the factory. This engine was also rebored with new valves. The concrete was also reinforced with a larger block poured around the existing block.

This manager went the chief one better. He arranged with an electrical power company for the installation of a 440 v line. He then installed several electric motors, some 125 hp in all. It was considerable time before we were able to get going again as all of this repairing took time as well as money.

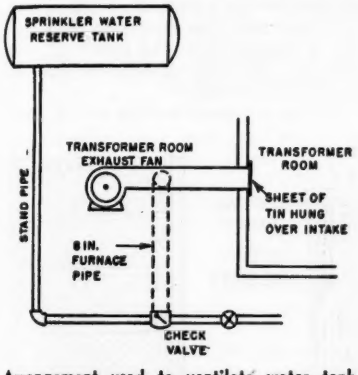
The day finally came to resume operations and what a different story from that before. I have always felt sorry that the chief wasn't there when we made our start, but like all men we must go sometime. His passing was due to a bad heart.

Those motors relieved the load enough so that the reach rods could be reset to 1/3 cut off, the safety cams adjusted and the engine still pulls the load satisfactorily.

PRACTICAL HINTS AND KINKS

Ventilating Water Tank During Painting

THE accompanying sketch shows how our sprinkler water reserve tank is ventilated when it is necessary to clean and paint the tank every 2 yr. The check is removed from the check valve and 8 in. furnace pipe installed from check



Arrangement used to ventilate water tank while painting interior surfaces

to intake duct of transformer room fan. A sheet metal strip is hung over the intake from transformer room so that all fan pull is directly on the stand pipe. Due to having a fire pump, the sprinkler system is still in operation and the theater is protected in case of fire.

Detroit, Mich.

WILLIAM J. BRADLEY,
Eng. in Charge
United Artists Theater

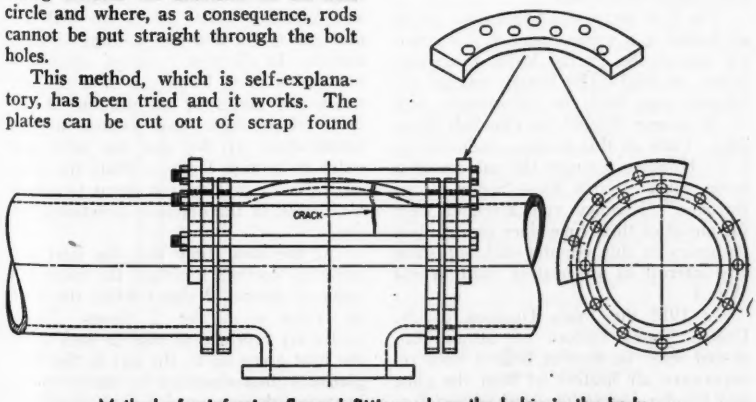
Reinforcing Flanged Fittings

By Charles A. Twinem

THE ACCOMPANYING DRAWING shows a method for reinforcing flanged fittings where the bulge in the body of the fitting exceeds the diameter of the bolt circle and where, as a consequence, rods cannot be put straight through the bolt holes.

This method, which is self-explanatory, has been tried and it works. The plates can be cut out of scrap found around almost any plant by means of a cutting torch.

The use of welding has removed a great many pipe and fitting difficulties but there are still a large number of old plants in service, where welding equipment is not easily available and where repair service is difficult to get. In such plants, the method suggested here should prove of value.



Method of reinforcing flanged fittings where the bulge in the body exceeds the diameter of the bolt circle

Manifold Eliminates Trouble from Freeze-Ups

By John F. Slavinsky

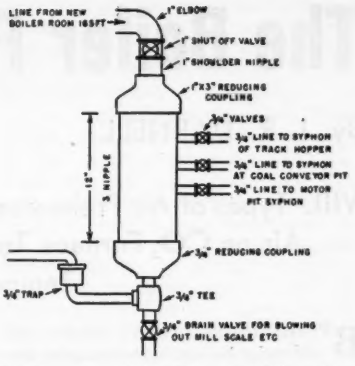
A SHORT TIME AGO we installed a new 60,000 lb per hr C. E. steam generator and decided to use the old coal conveying system with an extension to the new coal storage bunker over the new boiler.

The old boilers were sold and the old boiler room is being used for storage of spare equipment. In this coal conveying system we have to use steam syphons for syphoning rain water and seepage. One syphon is located underneath the track hopper. The second syphon is located at the coal elevator pit. The third syphon is located in the meter pit.

We were using a 1 in. steam line to these syphons and during the winter months the temperature in the old boiler house would be slightly above the outdoor temperatures. This steam line ran from the present connection to these syphons for a distance of 165 ft.

During the time the syphons were not in use, the line would freeze up. Sometimes the fittings would crack or split and had to be renewed. Several times we left the shut-off valve cracked open a little to keep the line from freezing.

We then made up a small steam manifold out of pipe and fittings as shown in the accompanying sketch, and


LINE FROM NEW BOILER ROOM 165FT
1" ELBOW
1" SHUT OFF VALVE
1" SHOULDER NIPPLE
1"x3" REDUCING COUPLING
3/4" VALVES
3/4" LINE TO SYPHON OF TRACK HOPPER
3/4" LINE TO SYPHON AT COAL CONVEYOR PIT
3/4" LINE TO MOTOR PIT SYPHON
18" 3 NIPPLE
3/4" REDUCING COUPLING
3/4" TRAP
3/4" TEE
3/4" DRAIN VALVE FOR BLOWING OUT MILL SCALE ETC

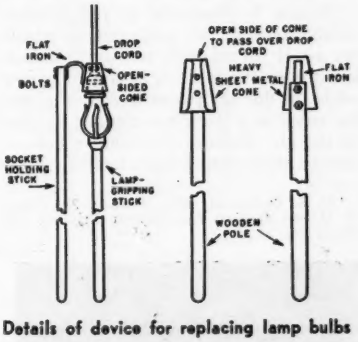
Details of manifold. The manifold outlets were drilled and tapped for ¾-in. pipe and the nipples were screwed in after which they were welded. The trap used was a ¾-in. thermostatic type and discharged outdoors into a culvert

installed a trap. Since that time we have had no more trouble with freeze ups. In passing on this information it may be of some use to one of our members of the power game.

Tool For Replacing Lamp Bulbs

By Thomas Trail

LAMP BULBS out of normal reach are usually replaced by means of a lamp-gripping stick. This method is successful where the sockets are firmly mounted in fixtures but not where the sockets are

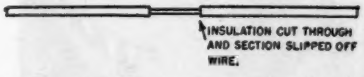


Details of device for replacing lamp bulbs

attached to drop cords. Lamps on drop cords may be replaced by means of a lamp-gripping stick if a second stick, having an attachment to hold the lamp socket is used. Such a device is shown in the accompanying illustration.

Wire Sleeving Substitute

A GOOD SUBSTITUTE for short lengths of wire insulating sleeving can be obtained by removing sections of insulation from the new synthetic-insulated wires known as type SN wire. The correct



length can be measured and a cut made through the insulation all the way around the wire, after which the insulation will slip off the wire readily.

The Boiler Fireman's Handbook

By J. R. DARNELL

VIII. Types of Air Preheaters and the Effect of Preheated Air on CO_2 Furnace Temperature and Flue Gas Temperature

BY ABSORBING HEAT which would otherwise be lost in the escaping flue gas, air preheaters not only save fuel in direct proportion to the sensible heat which is returned to the furnace but the preheated air which returns this heat has several additional effects. It increases the furnace temperature which in turn decreases the flue gas temperature. It also promotes more rapid combustion, increases the CO_2 and decreases ash pit loss in the case of coal firing. These effects will be explained in detail later on.

Types of Air Preheaters

Air preheaters for boilers are generally divided into two main classes, of which each is divided into two types as follows:

1. Recuperative
   - A. Tubular types
   - B. Plate types
2. Regenerative
   - A. Stationary elements
   - B. Rotating elements

Figure 1 illustrates a recuperative tubular type of air preheater in which the air is forced back and forth across and around the tubes by means of baffles while the flue gas passes directly through the tubes in a direction counter to that of the air. Casings for tubular heaters may be either round or rectangular. Figure 2 shows a sectional elevation and plan view of a tubular heater with rectangular casing. The same arrangement of baffling, however, may be used with the circular design of Fig. 1.

The tubular air preheater was the first successful type developed. In 1828 James B. Neilson obtained a British patent on apparatus which he used to improve combustion in blast furnaces in Glasgow, Scotland. Neilson, however, did not utilize waste heat but instead heated his air in a separately fired wagon-type locomotive boiler.

The first successful application of an air heater to a steam boiler in this country was at the Pacific Mills, Lawrence, Mass., in 1882. The heater was of the tubular type built in accordance with U. S. patent 205,282 by Obadiah Marland. Tests on this heater, conducted by J. C. Hoadley, formed the subject of a book called "Warm Blast Steam Boiler Furnace." Hoadley and Marland were far ahead of their time since power plant designers in this country did not show any interest in air heaters until World War I.

In 1918 the Fuels Division of the United States Bureau of Mines conducted tests[1] on marine boilers with recuperative air heaters of both the plate and tubular types. The author was fortunate in assisting in these tests, which were the first recorded tests made in this country after Hoadley.

It was not until 1923 that air preheaters were installed in any large central stations in this country. These were at the North East Station of the Kansas City Power & Light Co., the Colfax Station of the Duquesne Light Co., Pittsburgh and the Calumet Station of the Commonwealth Edison Co., Chicago.

Figure 3 shows the arrangement of the plate type heater installed at Colfax wherein there are two banks of chambers or envelopes placed back to back. Figure 4, taken from a patent drawing, illustrates the baffling for the air inside individual chambers as found in most designs of plate type air heaters. The air flow in this arrangement where the inlet and outlet openings are on the same side is designated as "U flow." If the inlet and outlet are on opposite sides it is called "S flow."

In the regenerative class of air preheaters, one design of the stationary type consists of a multiplicity of plates suspended loosely in a casing which, in its simplest form, is divided into two sections. A motor-driven mechanism operates inlet and outlet valves for both air and gas at the top and bottom of each section. In the first cycle of operation, hot gas is draw by means of a fan between the plates in one section. After these plates have been heated to the temperature of the gas the inlet gas valve to section 1 closes while the inlet air valve to that section opens to admit air forced in the opposite direction by a fan.

At the same time that the inlet gas valve to section 1 closes, the inlet gas valve to section 2 opens while the inlet air valve to section 2 closes. These cycles are repeated so that in each cycle the heat given up by the gas to the steel plates is then absorbed by the air passing over these same plates in the next cycle. This type of air heater occupies

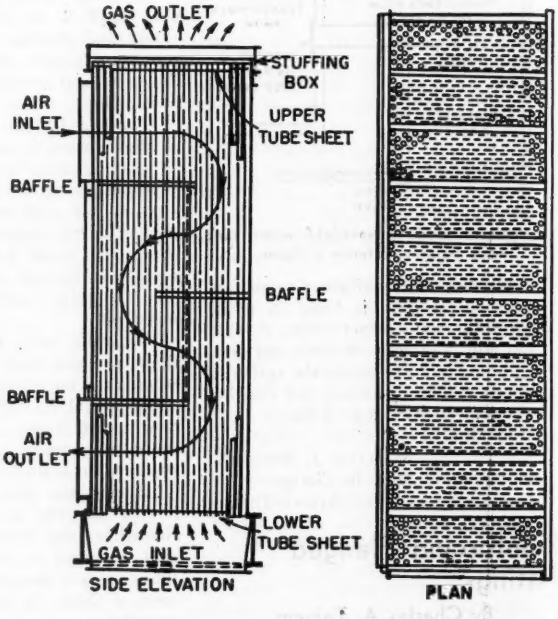


Fig. 2. The sectional elevation of this figure shows the path of air flow in this tubular air heater with rectangular casing or with circular casing as in Fig. 1. Note the staggered arrangement of tubes in the plan view.

[1] U. S. Bureau of Mines Bulletin 214, Tests of Marine Boilers; Government Printing Office, 1924.

Fig. 1. This is a tubular type of recuperative air preheater with a circular casing.

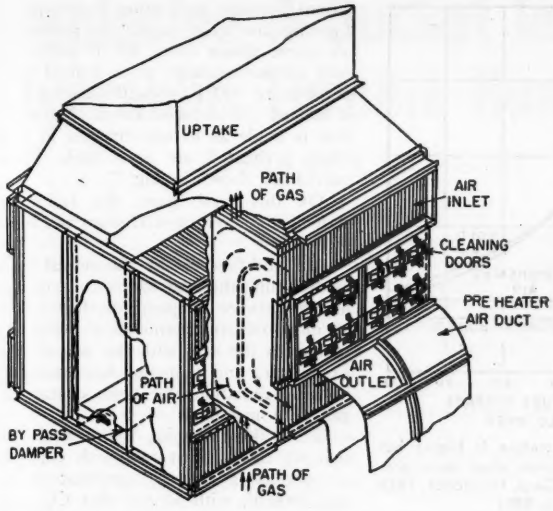


Fig. 3. This is a cut away section of the uptake of a boiler at Colfax Station showing the arrangement of a plate type air heater with two banks of chambers placed back to back.

considerable floor space and usually is not installed in boiler plants.

A modification of the regenerative principle of heating is found in the rotating type of heater, as shown in Fig. 5, in which the circular casing is divided horizontally into three compartments. The upper and lower compartments are divided by vertical partitions which confine the flue gas to one side and the air to the other. The middle compartment contains a slow moving rotor which provides the heating surface for the air. The arrangement shown in Fig. 5 is designed with integral propeller type fans for both air and gas. For large units, these fans are omitted and independent centrifugal type fans are provided.

The heating elements, which are closely packed into the rotor, consist of corrugated steel sheets alternating with sheets in undulating form as shown by Fig. 6, in which the corrugations, A, are placed vertically and the undulating sheets, B, are horizontal. This compact arrangement of steel sheets provides a large amount of effective heating surface in a very small space and the weight of the apparatus is considerably less than heaters of the recuperative class when designed for the same capacity.

While the regenerative types of air heaters are very effective in transfering heat from the gas to the air, care must be taken to prevent leakage from one side to the other. Since the air is at a pressure slightly above atmosphere while the gas pressure is negative or below atmosphere, there may be leakage of the air into the gas by way of the seal which bears on the rotor and acts as the partition separating the two compartments. Another source of contamination of the flue gas is the air which may be entrained in the honeycomb-like structure of the rotor as it passes from the air side into the gas side. At times, this may lead to false temperature readings for the flue gas leaving the heater and lead to the conclusion that the heat transfer rate or efficiency of the heater is greater than it actually is.

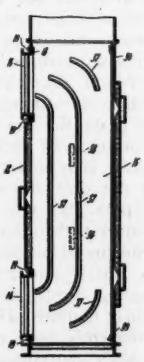


Fig. 4. Here is the arrangement of baffling for the air in "U" flow inside each chamber of a plate type air preheater.

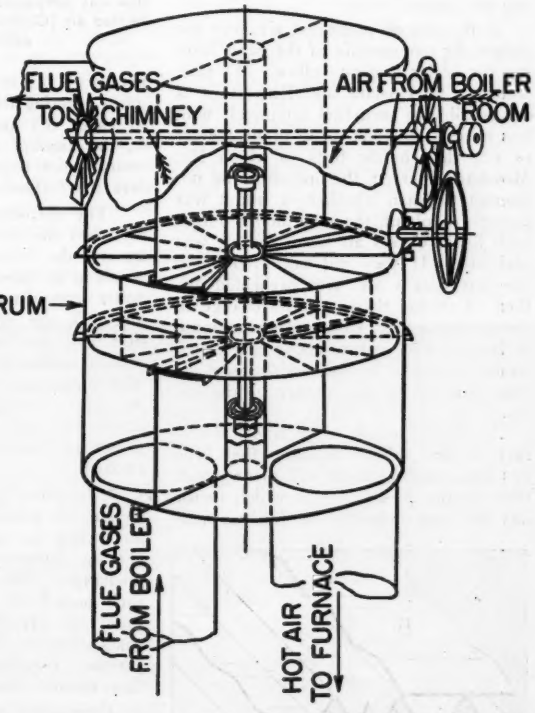


Fig. 5. In the rotating type of regenerative air heater one arrangement of gas and air flow is shown by this phantom view.

Effect of Preheated Air on CO_2 and Gas Temperatures

Firemen and engineers in power plants where air preheaters are installed sometimes ask whether or not preheated air used for combustion can cause a decrease in flue gas temperature as compared to the use of cold air for the same boiler output.

It was explained in Chapter II (September, 1944, issue) why flue gas temperature goes up when the CO_2 goes down and that, conversely, high CO_2 lowers the flue gas temperature in spite of the increased furnace temperature. It has been found that the rate of heat transfer, chiefly by primary radiation, caused by the temperature of the incandescent fuel bed (or flame alone in the case of gas or oil firing) increases approximately as the difference of the fourth powers of the furnace temperature. This is in accordance with the Stefan-Bolzmann law of radiant heat transfer.

Whenever the amount of excess air is reduced and this results in increased CO_2 and higher combustion temperature, a lesser amount of heat will be carried from the furnace by hot gases, particularly since the gases themselves transfer heat by radiation. Although oxygen and nitrogen do not radiate heat, the proportion of these gases decreases as the excess air is reduced while CO_2 and water vapor which do have the power to radiate are less diluted by non-radiating gases. This means that although the rate of heat transfer by convection through the tube bank is decreased, due to the lower weight of gases when operating with higher CO_2, the increased percentage of CO_2 increases the heat transfer by radiation sufficiently to give a lower exit temperature than with lower CO_2.

With the above conditions in mind, let us now consider what happens when preheated air is used for combustion.

Engineers who should be in a position to know appear to have widely divergent opinion. Haslam and Russell in their book, "Fuels and Their Combustion," 1926 edition, page 294, in discussing the effects of preheated air, state:

"All combustion reactions are speeded up by increasing the temperature and therefore with preheated air it is possible to burn fuel completely with much less excess air than would be required if cold air were used."

On the other hand, in the November 1, 1930, issue of POWER PLANT ENGINEERING, page 1251, D. J. Mosshart, engineer for a large stoker company, says: . . . "inspection of the date from a number of tests with both cold air and preheated air shows very little justification for the statement that preheated air reduces the temperature of the gases leaving the boiler."

If the use of preheated air does not reduce the temperature of the gases leaving the boiler it must follow: (1) that, contrary to Haslam and Russell, it is not possible to burn fuel completely with less excess air when using preheated air or (2) that, in the tests to which Mr. Mosshart referred, the operators did not attempt to learn whether or not it was possible to obtain the same boiler output with lower excess air when the air was preheated. If they did not attempt to use less excess air with preheated air, then of course there was no change in the percentage of CO_2 and no increase in furnace temperature above that which would normally be due to the sensible heat returned to the furnace by the hot air.

A library search of technical literature on this subject indicates that little has been written which will throw much light on the question as to which factor has the most influence on flue gas temperature: (a) initial temperature of the gases entering the tube bank (b) weight of gases (c) quality of the gases, that is, the amount of carbon dioxide and water vapor present. One authority offers the following explanation:

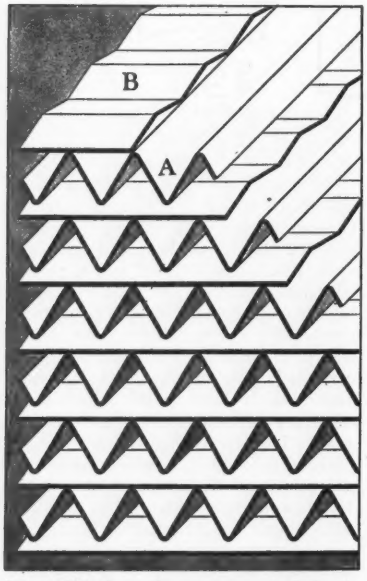


Fig. 6. This shows the arrangement of closely packed corrugated (A) and undulating (B) steel sheets serving as the heating surface in the rotor of the rotating regenerative heater of Fig. 5.

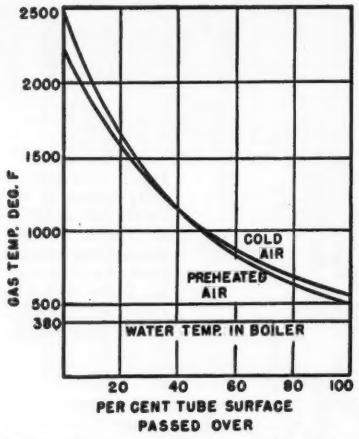


Fig. 7. Furnace temperature is higher but flue gas temperature lower when using preheated air (Cochrane Corp. Handbook, 1928 edition, p. 549).

"The introduction of preheated air increases the initial temperature of gas leaving the furnace, but seems also to result in an increased temperature at the boiler exit. In this case the excess air and CO_2 are unchanged. While radiation from the fuel bed and from the gas stream increases with the increased initial temperature, the dilution of radiating gas with non-radiating gas is unaltered and as a result the gas radiation is not as great as if the CO_2 were increased.

"Also there is little reduction in the weight of gases when using preheated air, hence the velocity of the flue gas passing through the nest of tubes is unchanged. The heat transferred from each pound of gas by construction is, thus, not greatly different and if the gases enter at a higher than normal temperature, they leave likewise at a higher than normal temperature."

Proponents of preheated air will argue that the flaw in the above statement is the assumption that the excess air and CO_2 are unchanged. To support the argument that preheated air does promote more rapid combustion, hence requires less excess air, one may refer to numerous authorities such as the Prime Movers Committee Reports of the National Electric Light Association, now the Edison Electric Institute, 420 Lexington Avenue, New York City, (see 1928 report) and various text books on combustion.

In the book, "Finding and Stopping Waste in Modern Boiler Rooms," 1928 (3d edition) published by Cochrane Corp., Philadelphia, Pa., the curve on page 549, shows a lower exit temperature with preheated air. Starting with a furnace temperature of 2500 F with preheated air, and 2250 F with cold air, the curves drop to about 1100 F after about 40 per cent of the heating surface has been passed, crossing each other at this point. Leaving the tube bank, the preheated air curve shows about 500 F while the cold air performance gives a final temperature of 550 F, notwithstanding that it started 250 degrees lower. No mention is made as to any changes in CO_2 when preheated air was used. These curves are shown in Fig. 7.

On this same page, the following statement corroborates Haslam and Russell:

"In addition to the theoretical gain by returning the heat to the furnace, the higher furnace temperature should lead to more efficient combustion, with less carbon in the ash, with the use of less excess air; and to better heat transfer, both by radiation and from contact of gas with metal."

From the foregoing it is conceivable that we might burn fuel with cold air to produce a furnace temperature of, say, 2500 F, with 14 per cent CO_2 and get a flue gas temperature of 500 F, while, in another case, using preheated air, we might start with the same furnace temperature or even somewhat lower but get a higher exit temperature if the CO_2 were lower, that is, in the range of 10 to 12 per cent. One conclusion which may be drawn is that the mere use of preheated air does not vaccinate operators from the effects of careless firing. On the other hand, if full advantage is taken of the fact that preheated air will permit more intense and rapid burning which makes possible complete combustion with much less excess air, careful tests should show lower exit temperatures when using preheated air.

The Danger of Obsolescence

Estimates are that around 50 per cent of the machines in some of our industries will be more than 20 years old when the war ends. This, in spite of the fact that improvements have been constantly made in their machines by equipment suppliers for these industries, making possible greatly increased efficiencies. The practical danger of holding onto old-style machinery has been demonstrated in factories which have failed to weather the storms of economic depression and competition at home and abroad, simply because they did not keep in step with advances in their production fields.

Some factories are using today outmoded equipment purchased at the time of the last World War, which is now doing its job with minimum efficiency and is a drag on the production program. The presence of such machinery in our factories is testimony to a false thrift which not only slows down production but puts men out of work in peace times, since it throttles demand for new, profit-making equipment.

Such false thrift is in turn largely a result of placing wrong interpretations on balance sheet findings. How management has frequently been misled in its thinking by such conventional terms as "book value," "market value," and "unrecovered investment" will be considered in the second article of this series.

Replacing A Bucket In An Hydraulic Turbine Runner

By FRANK I. MORGAN

SEVERAL YEARS ago a crack was found, near the crown, in one of the buckets of the lower runner (Francis type) of a double runner turbine at Holtwood. Repairs were made, at that time, by bridging the crack with splice plates of heavy strap iron, secured to the bucket with c.s.h. machine screws. The nominal diameter of the runner is 8 ft 4 in. and the inside diameter of the runner band is 9 ft 3½ in. It has 16 buckets and is made of cast iron. The unit is rated at 13,500 hp, 53 ft head, 94 rpm and it has been in service since 1910.

In January, 1942, during an inspection, it was discovered that this bucket had been completely broken out of the runner. The appearance of the break indicated that it had occurred a short time previous to the inspection. Since there was no possibility of making immediate repairs, the unit was returned to service and it was operated in this condition for several months, the reduction in capacity being inappreciable.

The missing bucket was recovered from the tailrace by a diver. It was returned to the turbine manufacturer who replaced the broken-out sections with type metal. It was then used as a pattern for the making of a new cast steel bucket.

When the new bucket was received the unit was taken out of service for its installation. It was found that the back of the bucket immediately following the missing one had been seriously attacked by cavitation. The inside of the runner band between the following bucket and the missing one had also been affected by cavitation. The guide bearing, immediately above the runner, which is rubber lined, was considerably enlarged, this accelerated wear being attributed to the unbalance caused by the absence of the missing bucket which weighed 600 lb. The sections of the missing bucket projecting from the crown and the band were chipped off and the surfaces ground smooth. Cast steel plates were then attached at these locations by the use of heavy machine screws and dowels. See Figs. 1, 2, and 3. Since it was difficult to procure stainless steel, carbon steel machine screws were used. They were "tinned" with 50-50 solder and this procedure proved effective in preventing corrosion of these screws. The new bucket was carefully positioned between the plates and then securely welded to them. To compensate for the unbalance caused by the plates to which the new bucket was attached, cast steel plates were secured to the crown and runner band diametrically opposite the new bucket.

About eight months after the installation of the new bucket, an inspection was made of the runner. The condition of the new bucket was, in general, quite satisfactory but it was found that the head was broken off of one screw in the top plate and one in the bottom plate, near the discharge edge of the bucket. In addition, one screw was missing from each plate at the same location. The screws in the top plate were not originally provided with fillets at the fillister head. They were all removed and machined to provide fillets after which they and the missing screws were replaced. When an inspection of the runner was made in July of this year no further trouble had developed and all machine screws were intact. It was thought that the presence of the plates at the ends of the new bucket might cause cavitation but up to this time none has developed.

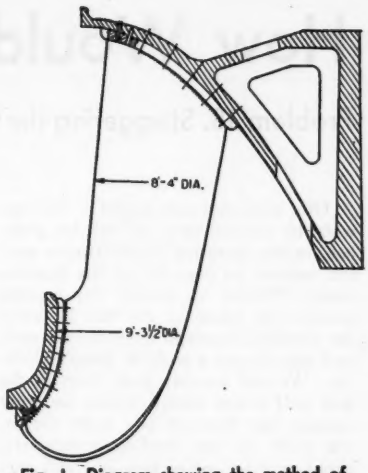


Fig. 1. Diagram showing the method of repair

Fig. 2. (Left) Photograph showing the attachment at the runner crown

Fig. 3 (Above) Another view showing the attachment at the runner band

How Would You Do It?

Problem 38. Staggering the Operation of Electric Welders

OUR HERO certainly pulled a fast one when he induced us to publish his problem on the operation of the twelve electric welders on page 105 of the January issue. Offhand it looked innocuous enough but when we got into it—when the solutions began to pour in—we realized that it was a wolf in sheep's clothing. We had scarcely gone through the first half dozen letters before we were cursing Our Hero up and down the entire scale of our profane vocabulary. From now on, we're through with that dope. What a bewildering array of circuits and gadgets, what a mess of relays and contactors, vacuum tubes, cams and tin whistles! How could anybody ever hope to make sense out of such a mass of electrical hodgepoge? Some arrangements were tied together with string (see 1st prize winner Berti's solution), others used troughs of mercury. There were cams and motor-driven contactors, time delay relays, signal lights, multiple contactors, in fact, about everything but the kitchen sink was pressed into service.

Don't infer from this, however, that the solutions were anything but good. There really was not a bad one in the lot. That was what made it so difficult to make the awards. While almost 90 per cent of the total number of solutions received solved the problem by the use of relays the remaining 10 per cent contained some of the best arrangements.

After analyzing and evaluating all factors entering the solution to the problem, the first prize was finally awarded to Roland Berti, whom it may be recalled sent in such an excellent solution of the capacitor-motor problem in the November issue. Mr. Berti received the first prize, first, because of the simplicity of his solution, secondly, because it satisfies all conditions and finally because it would not be expensive to install and makes use of more or less standard equipment.

The second prize to G. E. Vogel was made for practically the same reasons. Mr. Vogel's system, also, is simple and like Mr. Berti he provides for the possibility that two operators might start theirw elders simultaneously.

Our old friend Dennard Gusler who has been a frequent contributor to these pages was awarded the third prize with a duplicate third prize going to Lewis G. Coscia and A. S. Waxman. Mr. Gusler is now in training with the armed services but that fact does not deter him from sending in fine articles and solutions to these problems. In many ways, Mr. Gusler deserved more than third prize. His solution is outstanding in that it was the only complete "electronic" solution that was submitted. As Mr. Gusler said in his letter, "I could not resist Problem 38 because it seemed to be such a beautiful place to use electronic control." His solution is a splendid example of how to apply electronic control and he complies with all conditions of the problem. Admittedly, it is more complicated than some of the others systems and it was for that reason he comes third rather than first or second. At the same time it should be pointed out here that even though Mr. Gusler's diagram appears complicated, the components for the greater part are small and inexpensive. The thyratron tubes used are of low capacity and would not cost much. The only really complicated part in his scheme is the motor driven contactor. This would have to be made specially as would also some of the relays. The system is very ingenious, however, and deserves careful study.

The duplicate third prize to Coscia and Waxman is well deserved because their solution is practical and make use of a minimum amount of equipment, and all of the equipment is standard, and commercially available.

Comment on Other Solutions

Besides the prize-winning solutions, there were many other excellent letters, some of which will be referred to in detail in this analysis. The solution by Francis Wilson, for example, dividing the 12 welders up into three groups of four each and operating these groups two at a time by means of a cam switch is unique. It makes use of no relays whatever. Prescott Nichols of Reading, Mass., submitted two good solutions, one employing signal lights and the other an automatic system, both are worthy of mention. George Turner of Ticonderoga, N. Y., and R. E. Buffington of Philadelphia, also sent in simple and thoroughly practical solutions. All of these will be presented in more or less detail.

FIRST PRIZE AWARD

Roland Berti
Omaha, Nebraska

The simplest solution to this problem would be the installation of an overload current relay operating a series of signal lights, one at each machine, as shown in Fig. 1a. As the load reaches 400 kw the relay would close thus lighting each lamp and warning each operator that the generator capacity had been reached. This scheme has the obvious fault that an operator may choose to ignore the warning light and start his welder regardless.

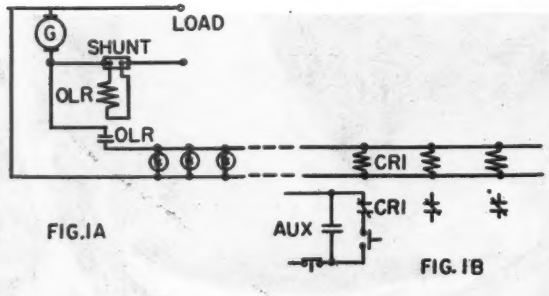
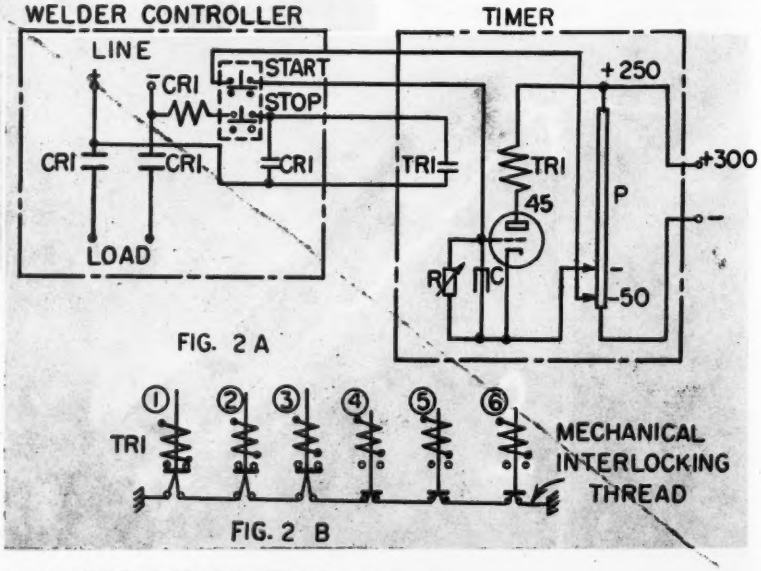


Fig. 1. (Left) Roland Berti's first scheme
Fig. 2. (Below) A more "foolproof" arrangement suggested by Roland Berti



A modification of this scheme is the substitution of single pole, normally-closed relays for the signal lights. Each relay contact would be in series with the "start" button on its machine as shown in Fig. 1b. When the generator capacity is reached all these contacts would open and the machines not already on the line would be "locked out." Each machine already on the line has its control circuit closed through the auxiliary contact on its starter and is not affected. As soon as the load drops below capacity the relay contacts all close restoring the control circuit continuity for the idle machines.

The fault with this plan is in the possibility of two or more operators having their "start" buttons closed, resulting in two or more machines coming on the line as one drops off, thus resulting in an overload. With 12 machines in service operating on a cycle of 2 min on and 4 min off, there would be, if properly staggered, an average of only 4 machines on the line at one time spaced at 30 sec intervals. To all practical purposes the plan shown in Fig. 1b should be and probably would be entirely satisfactory, as the probability of "ganging up" and two operators coming on exactly at the same instant would be remote.

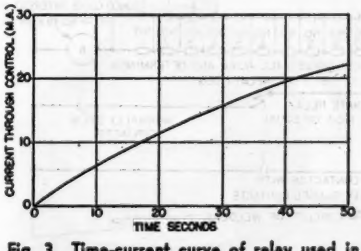


Fig. 3. Time-current curve of relay used in Berti's system

However, to make the setup strictly foolproof a plan could be devised to "lockout" the extra machines and allow them to come on only one at a time as the load conditions provide. Also it would be desirable to have a means of providing a "priority" to each oncoming machine so that they could come on the line in the order in which the operators press their "start" buttons. This would assure the first operator to get set up and ready to go, the first chance on the line. A suggested scheme for accomplishing this is shown in Fig. 2a and 2b.

The drawing in Fig. 2a is an elementary diagram stripped of unnecessary details. It relies for its operation chiefly on the well known principal of the "time-constant" of a resistor-capacitor combination.

With the "start" button in the normal position the capacitor, C, is connected across a portion of the potentiometer, P, and charged to some voltage such as 50 v. This places a bias of -50 v on the grid of the type 45 vacuum tube. When the "start" button is depressed this disconnects the capacitor from its source of voltage and it commences to discharge through the variable resistor, R, in parallel with it, in accordance with the exponential law for capacitor discharge through a resistor. As the capacitor discharges the grid bias becomes less negative and plate current begins to flow through the relay coil TR1. This coil should be wound to pick up its contacts at, let us say, about 5 ma but should have sufficient capacity to withstand several times that much current, for example, the rated plate current of the tube or 35 ma. When the tube passes 5 ma the relay coil TR1 picks up and closes its contact. This closes the circuit for CR1 and starts the welder. As the operator releases the "start" button the full negative grid bias is restored, the tube plate current drops to zero and relay TR1 opens. However, the control circuit for CR1 is now completed through its auxiliary contact and remains energized until the "stop" button is depressed.

The "time-constant" (the time it takes the capacitor to discharge to 37 percent of its initial voltage = resistance in megohms x capacitance in microfarads) for the R-C combination should not prove to be very critical, fifty seconds probably would be a satisfactory figure.

The "priority" feature is sketched in Fig. 2b. The twelve TR1 relays are mounted side by side on a common panel. The contact plungers or armatures as the case may be are mechanically "interlocked" by means of a strong thread such as catgut or a fine wire, as illustrated. Enough slack is provided to allow 8 relays to close. (only 6 are shown for illustration.) In the case illustrated suppose only three relays could be closed at one time, and that relays 1, 2, and 3 were closed as shown and operator 4 were to push his "start" button at one instant, operator 5 at ten seconds later, and operator 6, twenty seconds later. Then if operator 1 were to release his machine at the end of, say thirty seconds, the conditions as shown in Fig. 3 would prevail. The relay coil for operator 4 would be carrying 15.75 ma; for operator 5, 11.55 ma; and for operator 6, 6.65 ma. The instant a relay for operator 1, 2, or 3 is released, the remaining relay having the largest current through it would snap shut and take up the slack in the "interlock." Meanwhile the other relays would continue to build up their currents as long as the operators held their "start" buttons depressed. If an operator should change his mind and release his "start" button he automatically releases his relay current and subsequently his "priority." As the waiting time becomes longer the rise in current becomes less pronounced and the differential between the relays decreases. If necessary the time-constant can be increased. Also the grid bias can be adjusted on the potentiometer if desired and in the event there are only 8 operators or less the grid bias can be adjusted to zero so that the tube conducts immediately and there need be no delay for the current to build up to 5 ma necessary to close the relays.

The timing relays could be mounted near the center of the 200 ft long production line, requiring four wires from there to each welder station. Also required would be a rectifier or other source of several hundreds volts d-c for plate voltage.

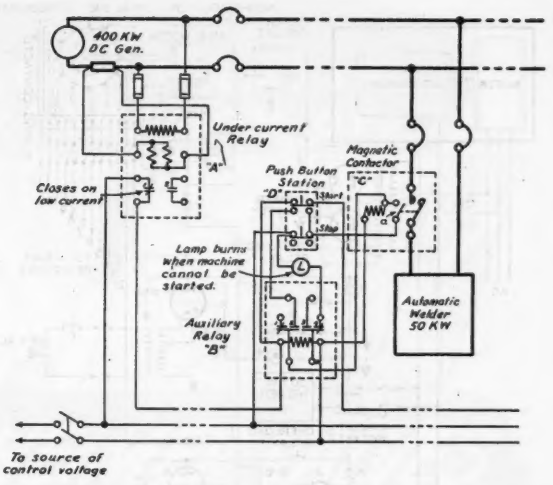


Fig. 4. Glen A. Vogel's Solution

SECOND PRIZE AWARD

Glenn E. Vogel
Chattanooga, Tenn.

In the solution of this problem, the governing of load has been made entirely automatic. Not only can no more than eight machines be connected to the generator at any one time but only one can be connected at a time. This has the advantage of eliminating sudden strains on the motor-generator due to several welders coming on the line simultaneously and is also necessary to prevent faulty operation of the load governing relay due to several operators trying to beat each other on the line when the load has dropped to a point where another machine can be carried.

In Fig. 4 the generator and its protective relay and one of the automatic welders with its control circuit is shown. Only one welder is shown as it is typical of all the welders. The generator protective relay, marked "A", consists essentially of a polarizing field coil connected across the generator leads, an armature coil connected to carry a def-

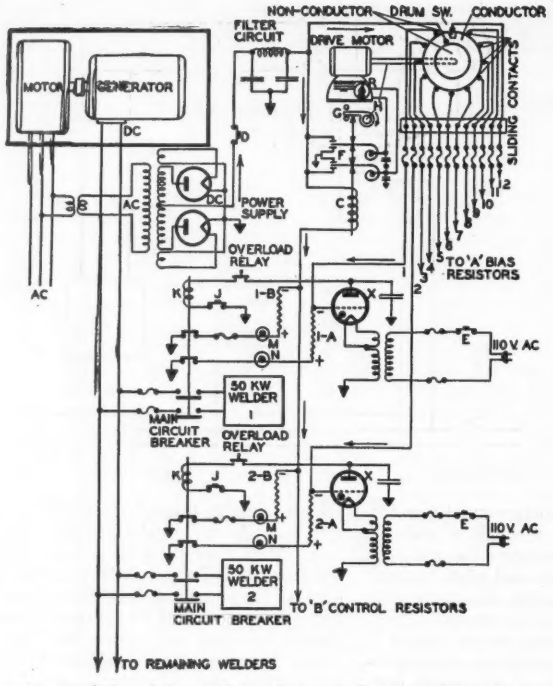


Fig. 5. (Above) Dennard Gussler went all out on electronics and did a fine job

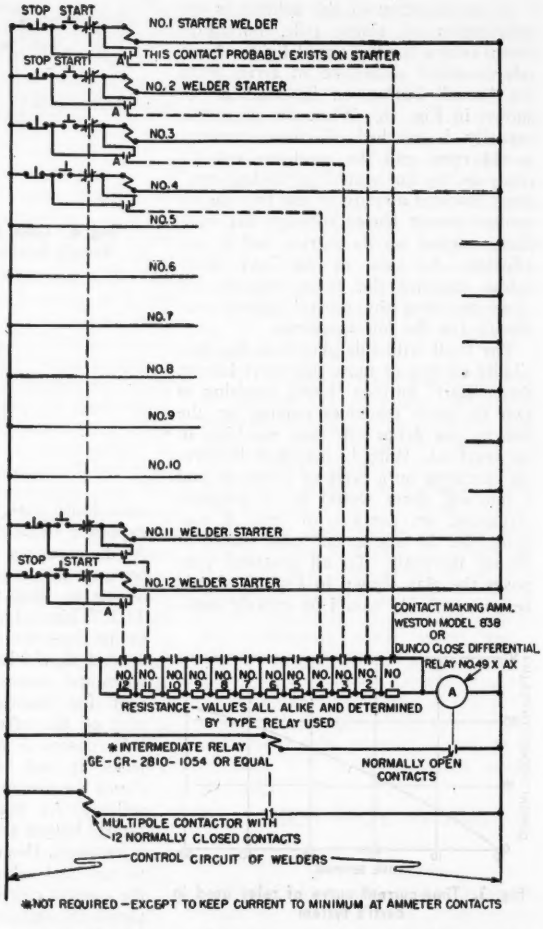


Fig. 6. (Right) Coscia and Waxman's system. It uses standard commercial equipment and is simple and practical

inite portion of the generator current, and two sets of contacts and calibrating devices. These contacts are so connected to the armature that when no current is flowing through the armature, contact 1 is closed and contact 2 is open. When sufficient current flows in the armature coil in the normal direction, contact 1 will be opened and held open until the current decreases below the point for which the contact is calibrated. Contact 2 is normally open and will be closed only by a reversal of current through the relay. This contact is not used in this scheme. The welder control circuit consists of an auxiliary voltage relay, marked "B", having two electrically separate double throw contacts, a magnetic contactor, "C", having an auxiliary switch, "a", which operates with the main contact, a push button station, "D", having "start" and "stop" buttons, each with one normally open and one normally closed contact, and a pilot light, "L", which burns only when the generator is loaded to capacity and no more welders can be added to the circuit, or when another machine is being started.

The method of operation is as follows: When the generator is running with no welders on the line, no current flows through the relay "A" and contact 1 is held closed by the calibrating spring. Control voltage is impressed on each of the auxiliary relays, "B", and each relay closes its number 2 and 3 contacts and opens its number 1 and 4 contacts. This extinguishes all of the pilot lamps and sets up the closing circuit of the magnetic contactors ready for the "start" push buttons to be operated. When a welder is ready to start, the "start" button for that machine is pressed. This completes the circuit to the magnetic contactor, "C", which closes and seals itself in through its auxiliary switch, "a". This machine is now on the line and cannot be disconnected by the action of any other machine. The magnetic contactor can be opened only by pressing its "stop" button or by failure of the control voltage. For the interval of time during which the "start" button is held down, the control circuit from contact 1 of relay "A" is opened and all relays "B" beyond the welder being started drop out and light their pilot lights. This prevents the starting of any welder further down the line until the start button is released. Welders closer to the generator may be started but no two can be started simultaneously as the one closest to the generator will block starting on the other.

This process is continued until a total of eight machines are connected to the line. When the eighth machine is connected, the current through the armature of relay "A" becomes great enough to open contact 1 and all of the auxiliary relays "B" drop out and the pilot lights are lighted. No more machines can now be put on the line as the starting circuit of all machines is open. Those machines which are already connected, however, are not affected as the holding circuit of the magnetic contactor is independent of the auxiliary relays. When one of the eight machines is disconnected, the current through relay "A" falls to value which allows the calibrating spring to close contact 1. This again energizes all of the auxiliary relays, extinguishes the pilot lights and sets up the starting circuits so that any machine can be started.

THIRD PRIZE AWARD

Dennard Gusler
Corpus Christi, Texas

The type of control used should be automatic and must in its operation satisfy several conditions that are enumerated as follows:

1. The maximum possible number of machines must be in operation at all times.

2. When coupled directly into a control device the human element is a variable factor which should be eliminated as completely as possible.

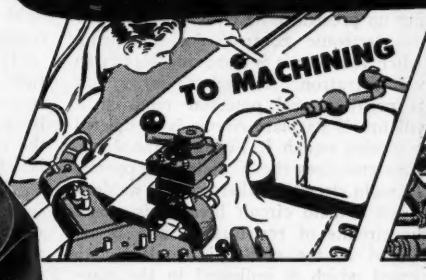
3. There should be practically no time delay between the shutting down of one machine and the starting up of another.

4. The control should be so designed that any welding process when once started will not fail due to the control used.

5. Due to load fluctuations on the d-c generator it is desirable that the control depend upon its own circuit constants for its operations.

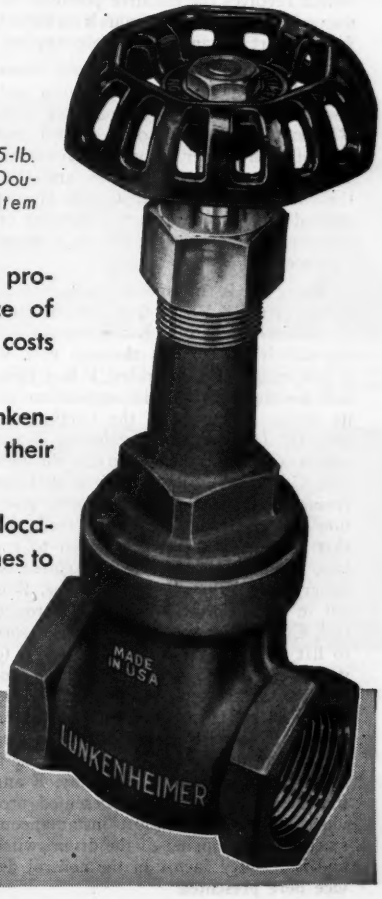
Quality RULES SUPREME IN PRODUCTION OF...

LUNKENHEIMER VALVES



● *Fig. 16 — Bronze "RENEWO" GLOBE*

● *Fig. 2125 — 125-lb. S. P. Bronze Gate, Double Disc, Rising Stem*



● At every step in manufacture, *Quality is the watchword at Lunkenheimer . . .*

Quality you can *see* in every line of a Lunkenheimer valve . . . plus *built-in* quality that reveals itself in top performance and longer service life when these finer-made valves are put to work.

Simplicity of design, correct proportions and perfect balance of all parts, reduce maintenance costs to a very minimum.

On every industrial front, Lunkenheimer Valves are proving their exceptional staying qualities.

A Lunkenheimer Distributor is located near you, ready at all times to assist with your maintenance and operating problems.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO, U. S. A.

NEW YORK 13 CHICAGO 6

BOSTON 10 PHILADELPHIA 7

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

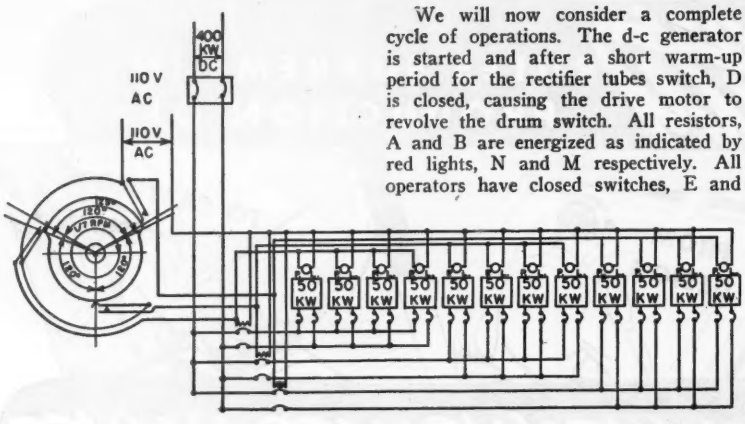


Fig. 7. Francis Wilson presents this unique timing arrangement

We will now consider a complete cycle of operations. The d-c generator is started and after a short warm-up period for the rectifier tubes switch, D is closed, causing the drive motor to revolve the drum switch. All resistors, A and B are energized as indicated by red lights, N and M respectively. All operators have closed switches, E and

Since it is evident that the control used must also function with great rapidity it would seem that an electronic control, with mechanical operation reduced to a minimum, such as shown in Fig. 5 is necessary to do the job required.

In Fig. 5 current from a full wave d-c rectifier power supply is being fed through a filter circuit to drum switch A, thence to resistors 1-A, 2-A, etc., in the electronic control circuit of each welder thus biasing the thyratrons, X to cut-off. Note here, that as the drum switch revolves the negative potential on the grid of each thyratron is removed for a short instant, then again applied.

Current from the filter circuit flows through relay, F to the drive motor and also through coil, C to resistors 1-B, 2-B, etc., in the electronic control circuit of each welder. Note that resistors, 1-B, 2-B, etc., are in parallel and that the current through coil, C will always depend directly on the actual number of resistors that are in parallel at a given instance.

Relay F is of special construction and is actuated by the iron core of coil, C. When 8 resistors, B are cut out of the circuit the current through coil, C is just enough to hold relay, F in a neutral position against the opposition of its spring contacts and the friction device, G. If less than 8 resistors, B are cut out of the circuit the current through coil, C is lowered to the extent that the spring contacts close in the lower position and the revolving motor shaft, H, that is causing the drum switch to rotate, holds the friction device against its upper stop. When the 8th resistor, B is cut in service the current flow through coil, C is sufficient to cause its iron core to lift the spring contacts of relay F to its upper position causing the drive motor to start to reverse. At the instant shaft, H starts to reverse the friction device, F is returned to its lower stop thereby opening relay, F or returning it to a neutral position. This relay, F and the method of operation presented provides a means of almost instantaneous starting and stopping of the drum switch and is the key factor in the control device here presented.

are setting up for a welding operation. When each operator completes his setting up procedure he closes switch, J of his electronic control. As the drum switch revolves it is removing bias from each thyratron. As each thyratron has its negative grid potential removed it will fire if its plate circuit is completed by closing switch J. Firing of the thyratrons energizes the K coils that operate the main circuit breakers of the welders. When a main circuit breaker is closed the circuits of resistors, A and B are opened in the electronic control concerned which is indicated to the operator by lights M and N going out. Thus, for example, during the time that the main circuit breaker to welder No. 1 is closed there is no current flow through resistors, 1-A and 1-B and they are effectively out of the circuit. When switch J is opened and the main circuit breaker opens, the resistors A and B are again placed in service. When the 8th welder goes into operation the drive motor and the drum switch cease revolving almost instantly because of the previously described action of relay, F.

When the welding operation of any one machine is completed the operator concerned opens his switch, J causing coil, K to de-energize thus opening the main circuit breaker which in turn puts resistors, A and B back in service. The current flow through coil, C caused by this resistor, B will actuate relay, F, starting the drive motor and the drum switch. Current through the A resistor again biases the thyratron except when unbiased by the revolving drum switch. The first thyratron unbiased by the revolving drum switch that has its plate circuit closed by switch, J will fire and the sequence of operations previously described is repeated. Until 8 welders are again in service the drum switch will continue to revolve.

In case of failure of the master control lights, M and N will go out but the welders that are in operation will not be stopped. The lights simply warn each operator that they are now on manual operation and they can notify the electrical department so that the master control can be repaired. Light M acts as a warning for the B resistor circuit and light N acts as a warning for the A resistor circuit.

If an individual thyratron circuit fails, the operation of the mcahine it controls will be suspended until the fault is corrected but the master control and the remainder of the machines will not be affected.

The drive motor speed may be adjusted with a rheostat, R so that the drum switch may be caused to revolve at a speed limited only by the time delay of the main circuit breakers. For example, it is obvious that the drum switch must revolve slow enough so that

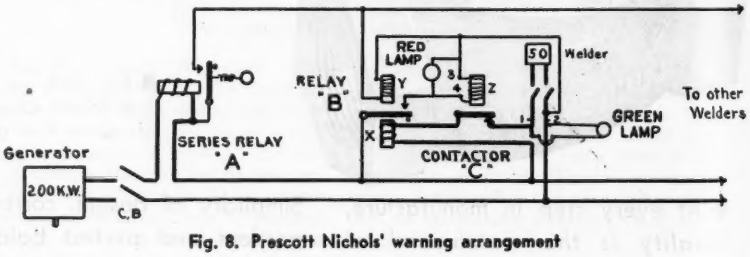


Fig. 8. Prescott Nichols' warning arrangement

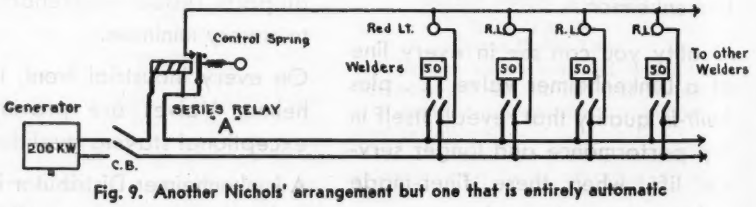


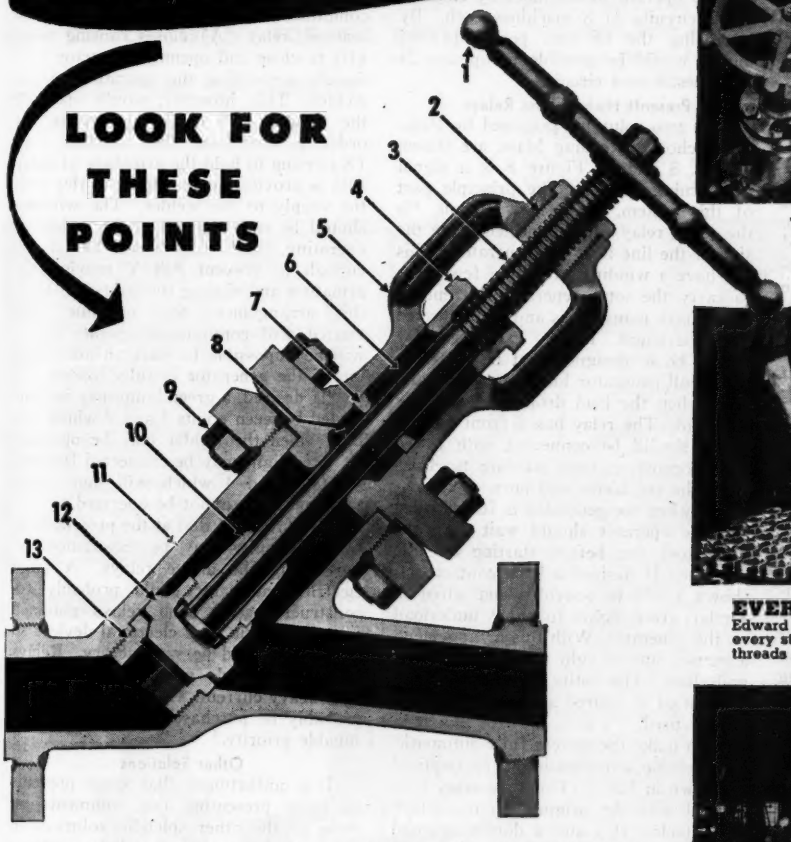
Fig. 9. Another Nichols' arrangement but one that is entirely automatic

after unbiasing the thyratron in the control circuit of welder it will not remove the bias from the grid of the thyratron in the control circuit of welder 2 until the main circuit breaker of control 1 has time to function if its switch, J is closed.

It is possible that the starting current required by the drive motor would affect the current flow through the coil C to the extent that more condensers would be required to hold the voltage constant than I have shown. The condensers required, their location, as well as fuses and their placement in the circuit are usually worked out during the time an

NUMBER TWO OF A SERIES ON VALVE SELECTION

How to buy a *Blow-off* VALVE . . .



FIT ANY SPACE. Edward steel blow-off valves are built in both straight-way and angle design, offering a variety of hookups to fit installation space needs.

EVERY-STAGE INSPECTION. Rigid Edward inspection procedures check all parts at every stage of manufacture. Inspector above gages threads of wear resistant EValloy valve seats.

FORGED. Drop hammers forge many parts of Edward blow-off valves for top strength in hard usage.

SYMMETRY. Fine-finish, perfect symmetry of EValloy stems is achieved by centerless grinding.

BORIZED. Mating blow-off seats and disks are precision borized at exact angles in same operation.

WELDING ENDS. Socket welding ends, as well as flanged ends, are available in Edward blow-off valves.

1 Handwheel. Strong, knobbed, easy to grip even with wet hands. Oversize dimensions make operation easier.

2 Yoke Bushing. Bronze. Completely machined in one set-up so internal and external threads are perfectly concentric.

3 Stem. EValloy stainless steel with low coefficient of expansion to prevent loosening in cooling.

4 Gland. Forged steel, smoothly machined to prevent binding or scoring.

5 Bonnet. Forged steel, integral yoke post design to prevent misalignment.

6 Packing. Die formed temperature resisting EValpak.

7 Junk Ring. Accurately fitted to stuffing box.

8 Cooling Chamber. Large condensate chamber to protect packing.

9 Studs and Nuts. Through bolted joint makes disassembly simple.

10 Disk Nut. Heavy steel with backseating surface for repacking under pressure.

11 Body. Streamlined steel body with no unnecessary parts to clog or erode.

12 Disk. EValloy stainless steel or Stellite hard facing, precision borized with mating seat.

13 Seat. EValloy or integral Stellite seat, mated with disk.

Built in three pressure classes—300 lb., 600 lb. and 900-1500 lb. sp.

NEW! Catalog 12-D covering Edward blow-off line soon off the press. Write for your copy today.

THE EDWARD VALVE & MFG. CO., INC., • EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES

electronic device is being tested prior to being put in service.

DUPLICATE THIRD PRIZE

Lewis G. Coscia and A. S. Waxman
Baltimore, Md.

This problem can be solved by limiting the number of welders which can be connected across the line by arranging the starting circuits as shown in the attached diagram.

A normally open finger will have to be added to each welder starter. When the welder is started, the finger would short out a resistance step in series with a contact making ammeter (Weston) model 838, or a Dunco No. 49XAX differential relay (Struther-Dunn, Inc.). The latter would probably make a better job since it works on a 5 percent voltage differential to give a snap action. The relay or ammeter would be adjusted to close its contacts when any 8 resistances are cut out. This would energize the multiple contactor to open the starting circuit of all welders. Welders which are already on the line would not shut down because of the holding circuit (marked A on the diagram) but the remaining four welders could not be started until the ammeter contacts are opened by shutting down one of the welders. The intermediate relay is not necessary except to give a more practical working circuit.

Honorable Mention

First deserving honorable mention is the solution proposed by Francis G. Wilson. As already pointed out, Mr. Wilson divided the 12 welders up into 3 groups of 4 each and then by means of a cam switch produces an arrangement having a 7-min cycle in which 8 welders are on the line for less than 2 min; the rest of the time there are only 4 machines on the line. Mr. Wilson writes as follows:

"Based on the assumption that 2 min is the average welding time and 4 min the average off-time it follows that some welders will require more than the average time. Setting the maximum welding time at 2½ min and the off-time at 4½, it appears that a timing device can readily solve the problem.

"Split the welding machines into 3 circuits of 4 machines each and equip each circuit with either a two pole or single pole magnetic switch with remote control. Current for the solenoid in the magnetic switch is furnished from the timing circuit of 110 v a-c. Timing device consists of a motor driven cam at the speed of 1/7 rpm. One revolution of the cam will consume the time of one welding cycle of 7 min.

"Fig. 7 shows circuits and cam wheel with 3 sets of contacts for remote operation of the magnetic switches. Included in the circuit is a pilot light for each machine to signal operator when his machine is on the line.

"During the 7 min cycle the 8 machines are on the line for less than 2 min. The rest of the time there are only 4. While this setup would have a tendency to slow the rate of the faster welders it would tend to increase the rate of the slower welders. It is very doubtful if production would be impaired. A definite time cycle has been established. Any waiting period had been eliminated.

"If only 8 welders are working the cam can be stopped on any two sets of contents and it would be impossible for any of the 4 remaining machines to come on the line.

"In the same manner it would be possible to operate 16 machines by employing 2 circuits of 8 machines each. By increasing the off-time period to 5½ min it would be possible to operate 24 machines, 8 to a circuit."

Prescott Nichols Uses Relays

The two solutions proposed by Prescott Nichols of Reading Mass. are shown in Fig. 8 and 9. Figure 8 is a signal or warning device. "The principle part of this system," says Mr. Nichols, "is the series relay (A) connected in on the side of the line near the generator. This can have a winding of only a few turns to carry the total generator current or it can have many turns and be connected across a shunt. In any case the relay should be so designed that it will close when full generator load is reached, and open when the load drops 50 kw below full load. The relay has a front contact which should be connected with a red lamp located at each welding machine. Thus the red lamps will burn at all machines when the generator is fully loaded and the operator should wait until the light goes out before starting an idle machine. If desired a back contact, not shown, could be provided and wired to similar green lights to show underload on the generator. With this arrangement, a burned out *red* light would not indicate underload. The entire red system could be omitted if desired and only the green system used.

"To make the system fully automatic, considerable complications are required as shown in Fig. 9. The same relay (A) is used with the original front contact. A contactor (C) and a double opposed coil relay (B) are provided for each welder. The contacts of contactor (C) are connected in the feeders to the welders and should be heavy enough to carry 50 kw. It should open when the coil is energized.

"This contactor is controlled by the front contact relay (B). Coil (Z) is wound so as to take the full generator voltage. Coil (Y) of relay (B) is also wound the same and is controlled by the original series relay (A). Under these conditions when full generator load is reached, relay (A) closes causing relay (B) to close and opening contactor (C) thereby preventing the operation of the welder. This, however, would open all the welders with disastrous results. In order to overcome this, another coil, (X) acting to hold the armature of relay (B) is provided, connected in series with the supply to the welder. The winding should be such that when the welder is operating, coil (X) will be strong enough to prevent coil Y moving the armature and closing the contacts. With this arrangement any machine once started will continue to operate but it will be impossible to start an additional one if the generator is fully loaded.

"If desired, a green lamp may be connected between points 1 and 2 which will light when the welder may be operated or a red light may be connected between points 3 and 4 which will light when the generator cannot be operated.

"It is realized that at the present time, some difficulty may be experienced in purchasing the above relays. A good electrical mechanic could probably reconstruct second hand relays obtained from dealers in used electrical devices so that they would be satisfactory. Relays "A" and "B" do not have to carry a very heavy current. Contactor "C" could probably be purchased new with a reasonable priority."

Other Solutions

It is unfortunate that space prevents us from presenting our comments on some of the other splendid solutions in this issue but an effort will be made to do so in the April issue.

Questions And Answers

Question No. 290

Help Wanted on Lubrication and Inspection Schedules

ALL TOLD, we probably have 250 motors in our plant, which serves a hotel. A day man looks afetr the oiling of motors around the boiler room and refrigeration plant; the night operator is responsible for oiling laundry equipment, while a handy man oils the elevators. I'd like suggestions from other engineers on making up an oiling and inspection schedule for all our equipment that I can check readily. Could it be some kind of board with tickets or tags on it? I've tried to fix up such a schedule board but can't get it to suit me.

Montgomery, Ala. W. E.

Editor's Note:—This is typical of a number of requests we have received lately from readers in hotels, manufacturing plants and service industries.

For example, E. P. of Nashville, Tenn., has a factory comprising 17 different departments, each with 5 to 25

Where the Call is for Piping Materials ....CALL ON CRANE

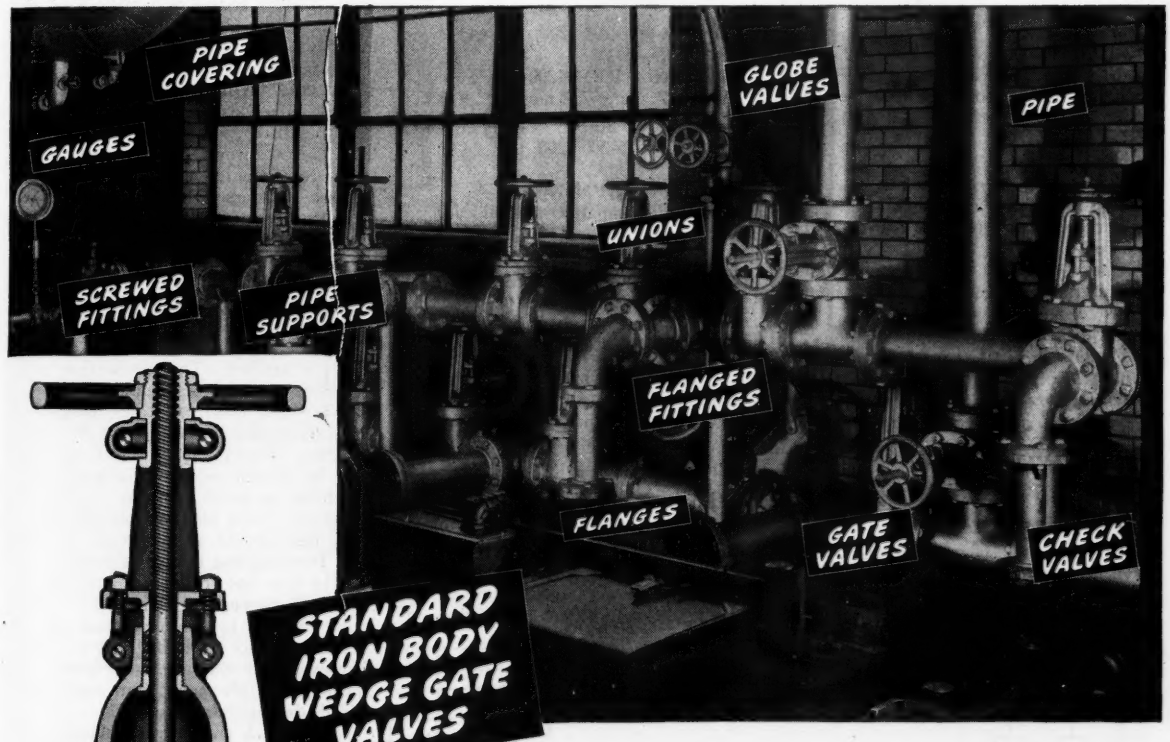
ONE SOURCE OF SUPPLY

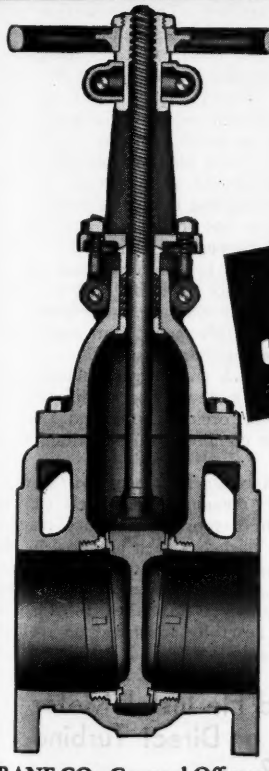
ONE RESPONSIBILITY FOR ALL PARTS

ONE STANDARD OF QUALITY

No matter what you need in piping materials, you can get them *all* from a single source—your Crane Branch or Wholesaler. There, the world's greatest selection of piping materials—in brass, iron and steel—is at your service. Uniform quality in every part—backed by a single responsibility—helps assure the best installation. Take advantage of Crane *complete* piping materials service to speed up deferred replacement work and keep pipe lines at peak efficiency. Crane has everything you need; for example, in Standard Iron Body Wedge Gate Valves, as shown below.

Piping hook-up for a battery of pumps





STANDARD IRON BODY WEDGE GATE VALVES

SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves with Brass trim are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O. S. & Y. and Non-Rising Stem patterns.**

Working Pressures

Size of Valve	Screwed or Flanged Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil, or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-inch, Crane 150-pound Cast Steel Gate Valves are recommended.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

machines requiring periodical lubrication. He has a good oiling man, Joe, who keeps track of these machines mentally and does a fine job. But what if Joe leaves or gets sick? E. P. wants to transfer the system from Joe's head onto some sort of a diagram or visual tag board. That's the sort of thing these readers want: actual diagrams and schedule forms and designs for tag boards or card file systems or other specific methods, rather than general comments on the principles involved. Will Q & A readers contribute their specific methods?

Question No. 291

What Do You Do About Boiler Feed Pump Corrosion?

I'D LIKE to know the ideas and experiences of other engineers with erosion and corrosion in boiler feed pumps operating at high pressure (900 psi) with pure water. This is one of our most annoying problems.

Most of our trouble is in the pump casings. At present, to help ease the condition, we recirculate a small quantity of boiler water.

In co-operation with the pump manufacturers, we have had all these pumps fitted with stainless steel liners. These seem to help some, but are not the complete answer. What have Q & A readers done about this problem?

Birmingham, Ala. R. H. H.

Question No. 292

How Divide Load Between Two Synchronous Converters?

I HAVE one 200-kw and one 300-kw synchronous converters operating in parallel, connected as shown in the diagram. I would like to know what per cent of full efficiency I can expect from these two machines, also what kind of a regulator I should have to keep them equalized so each will take its proper share of the load.

The machines will operate in parallel for 3 or 4 hr, each taking the correct amount of load; but then one machine or the other will begin to carry more load than it should have.

Each unit draws power from a separate transformer bank, as shown and each bank produces the same secondary voltage. On the d-c end, each machine circuit goes through hand and automatic circuit breakers to the common bus and there is an equalizer bus. Each machine has a manually-operated field rheostat.

Here are the name plate data:

Unit No. 1
Type H-00-6-200-1200
Form P — D. C.
Cycles 60 — RPM 1200
Volts 275 Amp 727 normal

Unit No. 2
Type HCC-6-300-1200
Form P — D. C.
Cycles 60 — RPM 1200
Volts 275 Amp 1090 normal

Wharton, W. Va. W. M. P.

Answer No. 280

How Fill Cracks in Concrete Chimney

C. L. S. does not elaborate on the condition of his stack, hence it is a bit difficult to advise on the best procedure to follow in rehabilitating it. I assume from the limited information offered that the stack will not require the benefit of compressed air tools to scale off the affected surface concrete to the point where a new layer may be applied. It is also important to know the size of the chimney and the condition of the foundation before much detailed information can be given. However, if the stack is in a reasonably good state of repair and the conditions prescribed are such that they can readily be corrected by the simple expedient of sealing up the cracks with mortar applied with a trowel and brush, that information is offered herewith.

Remove all loose and disintegrated concrete by hand tools, if the stack is small, and if compressed air for air tools is not available. The surface then should be roughly sand-blasted to remove any dirt and loose particles originally overlooked. The final cleaning should then be done with a stream of water to wash down any dust and to wet the surface of the work thoroughly so that the new cement does not set too fast. Slower setting will make a better bond with the old material.

The mortar is composed of one part Portland cement and three parts clean sharp sand. It must be well mixed and of about the consistancy to fashion good "mud" balls if rolled in the hand. This mix can be thrown into a crevice with great force to lodge it well back into the innermost recesses. Tamp this mix in with some type of improvised tamping tool.

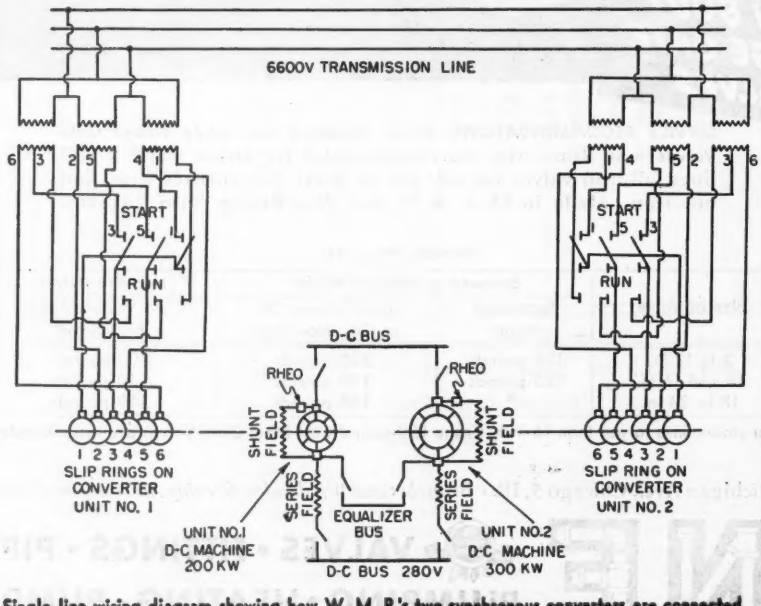
For large cracks it is recommended that the mortar be applied only to within several inches of the outer surface of the stack so that the initial application may partly harden before the final trowel finish is applied. This precaution prevents the mass from sagging or working outward and down, to cause bulges in the surface finish. When the first application is still green, the final coat may be applied with a finishing trowel and brush to match the outer contour of the stack. If the sand is a bit coarse, the final mix should be composed of one part Portland and two parts sand.

The hair line cracks will not respond to much superficial treatment. The cause for their presence lies much deeper than the surface in the majority of cases. However, for the average repair job, washing a brush-applied thin application will do for most small stacks.

Some brick and concrete stacks have been given a new lease of life by installing reinforcing bands and take-up devices at certain elevations along their length.

For large stacks, the use of "Gunite" is highly recommended which can be applied in a most satisfactory manner after the stack has been prepared by the use of compressed air tools, sand blasting and the installation of reinforcing mesh and steel. Detailed information will be cheerfully furnished on request.

Oak Ridge, Tenn. PAUL C. ZIEMKE



Single line wiring diagram showing how W. M. P.'s two synchronous converters are connected for parallel operation

Answer No. 282

Should He Install Motor Drive or Direct Turbine Drive?

Comparison of Three Types of Drive

THE OBJECT of this answer is to present the advantages and the disadvantages of three types of variable speed drives for a paper machine and suggest the most efficient drive. As described

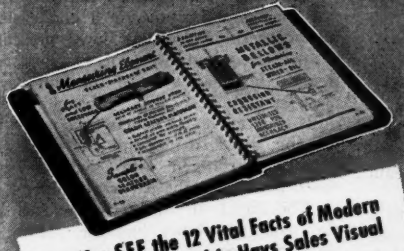
ELECTRICAL OPERATION IS AS MODERN AS POST WAR INDUSTRY MUST BE!

How HAYS Combustion Control saves miles and miles of footwork

LOOK at the steps necessary in manual operation of a steam plant—to adjust boiler dampers, air distribution, fuel feed, fan dampers—not to mention a dozen routine duties of operating, inspecting, maintaining.

Now look at the Hays Combustion Control method—orderly, harmonious, automatic, measures every variable accurately; translates every need for adjustment into operating impulses; transmits these impulses to the power units that make the adjustments: all done instantly—a complete and effective coordination whose advantages are accuracy, sensitivity, speed and power.

You get far more efficient combustion with this simple, well engineered, dependable method—save incalculable man-hours, save fuel, save important money. It's good business to *see* how it can help you by seeing the Hays Visual Presentation. A Hays representative will show it to you—and a line to us makes the contact.



...You SEE the 12 Vital Facts of Modern Combustion Control in Hays Sales Visual

The most comprehensive, most understandable explanation of automatic combustion control ever compiled. Ask the Hays representative to show it to you.

1. The purpose of Combustion Control.
2. How that Purpose is accomplished —3 methods of control.
3. What results can be expected of each.
4. Elements of a *good* control system.
5. Elements of a good controller.
6. *Coordinating* the controllers.
7. Selecting the best system for your needs.
8. How Automatic Combustion Control operates.
9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

The HAYS CORPORATION
SINCE 1905 — COMBUSTION INSTRUMENTS AND CONTROLS
MICHIGAN CITY, INDIANA, U.S.A.

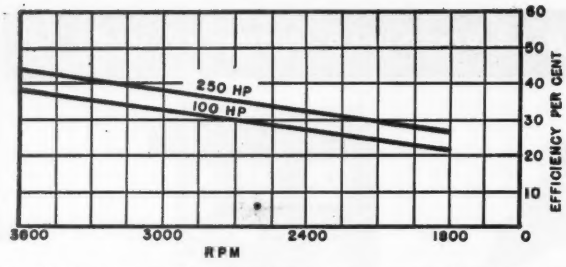


Fig. 1. Approximate efficiencies of 250-hp and 100-hp non-condensing steam turbines at speeds between 1800 and 3600 r.p.m.

by M. H., in the December issue, two paper machines, which require a drive of approximately 125 hp each, are in use and will be rebuilt as a postwar project. Steam at 10 psi will be required for process work in the manufacture of the paper. Although the condition of the boilers is not mentioned, it will be assumed that they are in good condition and will be modified so that they can generate superheated steam for the turbines.

Three common types of drives are available for use with the lines:

1. Variable speed non-condensing turbine direct connected to the paper machines.

2. Condensing turbo-generator with variable speed motors to drive the paper machines.

3. Non-condensing turbo-generator, exhausting at 10 psi with variable speed motors to drive the paper machines. The exhaust steam at 10 psi to be used for process work.

At the present time, steam is generated at both 150 psi and 175 psi and reduced to 10 psi for process work. The problem does not specify the steam requirements at 10 psi.

Curves showing the approximate efficiency of 250-hp and 100-hp steam turbines at speeds between 1800 and 3600 rpm are plotted on Fig. 1. These curves show that the highest efficiency of the turbine is obtained at the highest speed and that the 250-hp turbine is approximately 5 per cent more efficient than the 100-hp turbine at all speeds.

As 250 hp are required to drive the paper machines, the steam calculations will be based on the use of a 250-kw turbo-generator. A generator of this size will probably supply all the incidental electrical energy needed in a paper plant.

Curves plotted on Fig. 2 indicate the approximate steam consumption of a 250-kw turbo-generator and the energy, in Btu, in the steam when exhausted at 10 psi gage after generating 250 kw. Steam for the turbine should be superheated and the steam rate is plotted for various total temperatures of the steam at 190 psi absolute. The steam rate of a non-condensing unit exhausting at 10 psi is shown on curve "A" which shows that the steam rate decreases as the total temperature of the steam increases. Curve "B" shows the steam rate of a condensing turbine exhausting at 3 in. Hg absolute. This curve shows that the steam rate of a condensing turbine is approximately 50 per cent of the steam rate of a non-condensing turbine of the same capacity and that the steam consumption in pound per hour decreases as the total temperature of the steam increases. Curve "C" shows the energy in Btu remaining in the exhaust steam at 10 psi gage.

Steam at 190 psi absolute and with a total temperature of 600 F will be used for comparison of efficiencies in the following examples. The steam rate for a 250-kw condensing turbo-generator will be approximately 4700 lb of steam per hour from Curve "B," Fig. 2. The steam rate for a 250-kw non-condensing turbo-generator will be approximately 9225 lb of steam per hour from Curve "A," Fig. 2. The non-condensing unit will exhaust the steam at 10 psi gage making it available for process work.

Btu required to generate 250 kw-hr when condensing the steam at 3 in. Hg absolute:—

$4700 \times 1322.1 = 6{,}214{,}000$ Btu (1)

Btu in 9225 lb of steam at 10 psi gage: 10,790,000 from curve "C," Fig. 2. (2)

Btu required to generate 250 kw-hr plus Btu available in exhaust steam at 10 psi gage:—

$6{,}214{,}000 + 10{,}790{,}000 = 17{,}004{,}000$ Btu (3)

Btu required to generate 250 kw-hr and exhaust at 10 psi gage:—

$9225 \times 1322.1 = 12{,}197{,}000$ Btu (4)

Btu saved by generating 250 kw-hr and exhausting the steam at 10 psi for process work:—

$17{,}004{,}000 - 12{,}197{,}000 = 4{,}807{,}000$ Btu (5)

Per cent saving by generating 250 kw-hr and exhausting the steam at 10 psi for process work over generating steam in a boiler for process work:—

$100 - (12{,}197{,}000 \div 17{,}004{,}000) =$ 28.5 per cent (6)

The above calculations indicate that it is uneconomical to use a condensing turbo-generator, when low pressure steam is required for process work, although the steam rate of the unit itself may be very favorable. The choice of units, therefore, lies between non-condensing direct drive and the non-condensing turbo-generator and variable speed motors on the paper machines.

The direct turbine drive for each of the paper machines has the following disadvantages:—

Two turbines will be required to drive the machines. Each will be approximately 125 hp and will require separate steam pipes from the boilers. Maintenance also will be required for each unit.

The units will not be as efficient as a larger unit and the efficiency will decrease as the speed of the turbine is decreased.

The turbine will be located some distance from the boilers. Long steam headers from the boilers will increase the pressure drop through the pipes and will increase the heat loss by radiation.

Individual turbine drives cannot generate electrical energy for general plant use.

The direct turbine drive for each paper machine has the following advantages:—

The pipes for process steam can be connected directly from the turbine to the paper machines.

Approximately 9225 lb of exhaust steam per hour at 10 psi gage will be available for process work (from the turbines).

Power wiring and variable-speed motors will not be required.

A turbo-generator with variable-speed

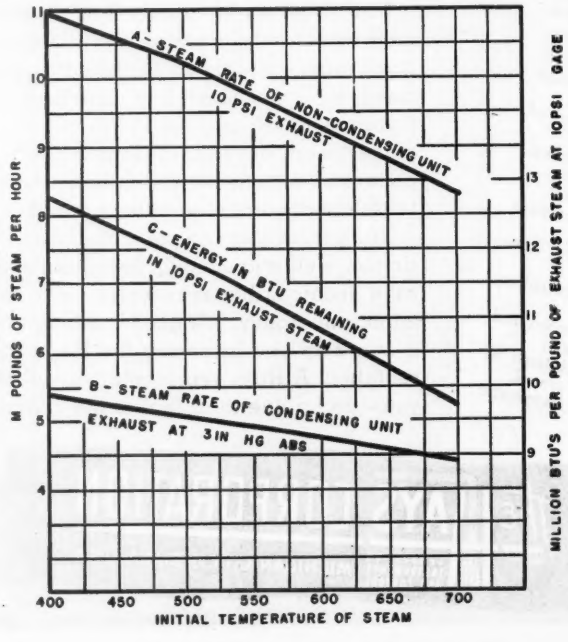


Fig. 2. Approximate steam rates of non-condensing and condensing 250-kw turbo-generators, curves A and B and energy in Btu in exhaust steam at 10 psi after generating 250-kw, curve C. Initial pressure 190 psi absolute

AJAX *Spiral Wound* METAL and ASBESTOS GASKETS

ENGINEERED TO WITHSTAND PRESSURES FROM 10 PSI UP

AJAX Gaskets are made to a rigid standard . . . which is your guarantee of consistent operating efficiency under any required service condition.

EVERY AJAX GASKET MEETS THESE ESSENTIAL REQUIREMENTS:

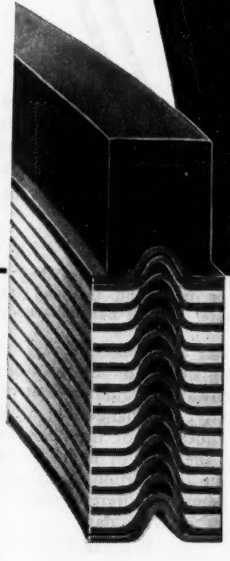
1. Positive, leak-proof seal
2. Easy installation
3. Freedom from trouble in service
4. Delivery

There is an AJAX Gasket for every connection in your plant engineered to this standard. Here are simple construction facts:

A single strip of metal is preformed into a U-shaped groove and wound spirally from the inside to the outside. Two parallel thicknesses of UGASCO Asbestos filler are inserted between each metal ply. A functionally important air space between each of these thicknesses of asbestos makes AJAX "the gasket that breathes."*

Standard AJAX Gaskets cover pressure ranges from 10 psi and up. Gaskets for varying pressure conditions are wound within a set OD and ID.

AJAX Spiral Wound Gaskets are the product of years of specialized experience in "gasket-engineering." Send your requirements and write for data sheets and samples today



*THE STORY BEHIND *"THE GASKET THAT BREATHES"*

Note on this cutaway drawing, the small air space under each U-groove in the metal ply.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions—and retains the positive, secure seal you require at all times.

A FEW OF THE SHAPES AND TYPES AVAILABLE

A WORKING MANUAL OF AJAX GASKETS

CATALOG 202

COMPLETE DATA
Specifications—Prices

SEND FOR YOUR COPY

In Texas and Louisiana, AJAX Gaskets are known as STERL-TALLIC and are distributed by Sterling Packing and Gasket Company, Houston, Texas.

U. S. GASKET CO.

1596 PIERCE STREET, CAMDEN, NEW JERSEY

motor drive for each of the paper machines has the following disadvantages:—

Exhaust steam pipe from the turbine exhaust to each of the paper machines with loss of heat by radiation.

Power wiring and variable-speed motors will be required for each of the paper machines.

A turbo-generator with variable-speed motor drives for each of the paper machines has the following advantages:—

A single unit with the highest possible efficiency will be used. The unit will be located close to the boiler. Supervision of boilers and turbine will be centralized. Maintenance will be required for one unit only.

The high pressure steam piping, which which will be short, will have the minimum pressure drop and will have the minimum loss of heat by radiation.

The paper machine will not be complicated by the presence of high pressure steam piping.

Approximately 9225 lb of exhaust steam per hour at 10 psi gage will be available for process work.

The installation of a 250-kw turbo-generator, operating on steam with an initial pressure of 190 psi absolute and a total temperature of 600 F and variable-speed motor drives of each of the paper machines is recommended. This unit will be highly efficient because a turbine is inherently a constant-speed prime mover whose best efficiency is obtained at high speed when directly connected to an electric generator. A 250-kw turbo-generator will supply all the electrical energy required for the paper machines and will also supply the incidental electrical energy required in the paper factory. A 250-kw turbo-generator will also supply approximately 9225 lb of exhaust steam per hour at 10 psi gage for process work in the paper machines.

Baltimore, Md. LEWIS G. COSCIA

Answer No. 283

Why Is Water Level Hard to Control?

Cause Is Swelling and Shrinkage of Water

No MATTER how carefully planned, there are always some "bugs" in a new installation; and G. B.'s new bent-tube boiler was no exception. In his case the new boiler has a violently fluctuating water level.

During recent years, smaller boiler drums and rapidly fluctuating loads have contributed to complicate the feedwater control problem. Theoretically, the flow of feedwater through the regulator should be proportional to the steaming rate of the boiler, and the amount of solid water in the boiler should be the same for all loads. Such a feedwater regulator requires the installation of flow meters, oil control, air control, etc., expensive equipment found only on the larger units. Small units have the amount of solid water in the boiler regulated by the height of the water in the drum.

G. B.'s cross drum boilers, Fig. 1, are efficient, economical, and reliable; but

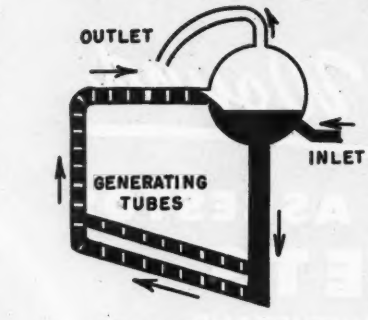


FIG. 1
CROSS DRUM BOILER

KEY
STEAM
STEAM AND WATER
SOLID WATER

Fig. 1. Diagram showing principle of steam generation in cross-drum boiler

this type of boiler does not respond readily to load changes, due to the horizontal position of the generating tubes and the method of baffling the flue gases. A feedwater regulator designed for this type of boiler may be relatively slow in operation, as speed may be sacrificed for dependability and low cost.

The outstanding characteristics of the new four-drum bent-tube boiler, Figs. 2 and 3, are its responsiveness to heavy and sudden demand for steam, its ability to deliver dry steam under such adverse conditions as operation at high ratings with water of high concentration of solids. These desirable qualities are due to the large reserve water capacity, the vertical arrangement of the steam generating tubes, and the arrangement of the steam and water circulators between the drums. Such a unit permits a feedwater regulator control system only about one-tenth the time in which to function upon a change in steaming rate as compared with the cross drum boiler.

With an increase in steaming rate of the bent-tube boiler, much of the water space being in the generating tubes, a much greater percentage of the volume

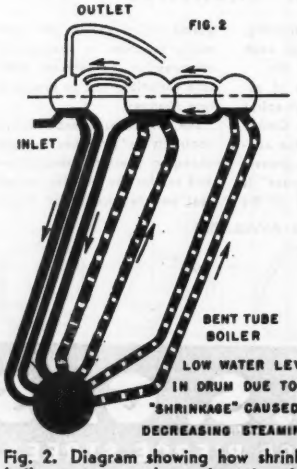


Fig. 2. Diagram showing how shrinkage of boiler water on decreasing steaming rate lowers boiler water level in bent-tube boiler

below the surface of the water is occupied by steam and may be as much as 20 per cent. Since only 10 to 15 per cent of the total volume of water in the boiler is in the upper drums at normal water levels, it follows that the drum water level will be affected by changes in the rate of steaming. An increase in load, for instance, resulting in a slight drop in steam pressure is immediately followed by increased steam generation due to the heat stored in the boiler water. This will cause the water level in the drum to rise momentarily, Fig. 3, due to the increased volume of steam bubbles below the water level. Similarly, a sudden decrease in load will result in a drop in the drum level, Fig. 2, due to the decreased volume of steam bubbles below the surface of the water. Sudden load changes are responsible for the "swell" and "shrinkage" of water in the boiler drums.

As the 3 boilers operate on the same header, the bent-tube boiler not only has to take care of its own ⅓ increase of the load, but also the ⅔ the cross drum boilers do not pick up immediately.

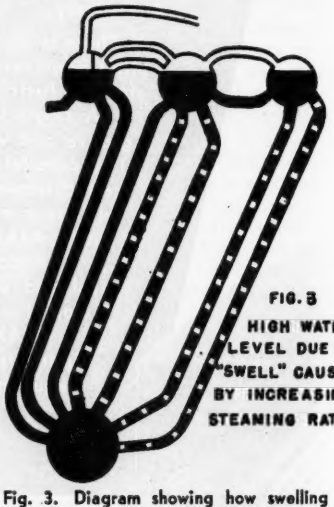


Fig. 3. Diagram showing how swelling of boiler water on increasing steaming rate raises boiler water level in bent-tube boiler

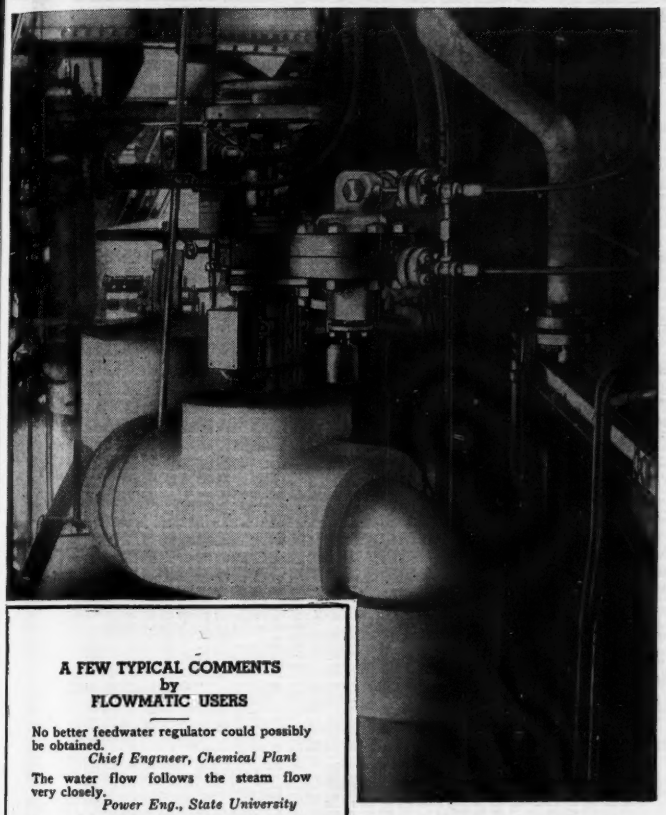
Remedies for this condition may be: a load limiting device on the bent-tube boiler; a feedwater regulator that responds instantly to changes in drum water level; education of the plant employees to see the folly of undue strains placed upon the boiler room equipment; cooperation between different users of tributed during the work day.

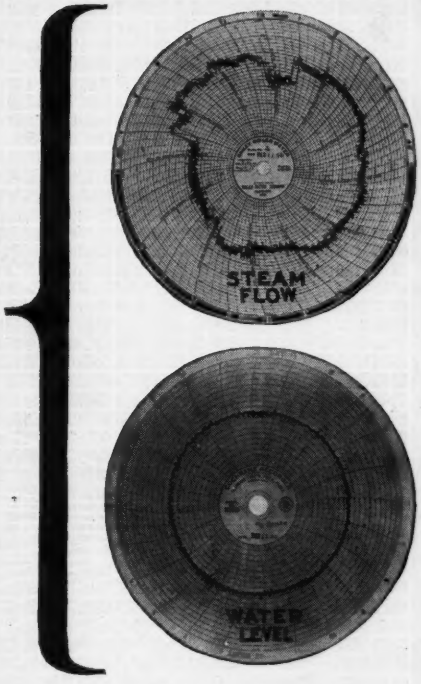
Chicago, Ill. WALTER HEIDECKER

Editor's Note:—For a detailed explanation of just how the steam is generated and of the action of the steam and water in bent-tube boilers under load fluctuations, see the authoritative article, "How Steam Is Released in Water-Tube Boiler Drums," by Max H. Kuhner, POWER PLANT ENGINEER, *September, 1944, pages 92-94.*

A number of other interesting comments by readers will be published in subsequent issues, as soon as space is available for them.

"FLOWMATIC *Protected*"





This 4" Copes Flowmatic in an Eastern Utility Plant safeguards feed water supply to a 675 psi 125,000 lb. per hour integral furnace boiler. With fluctuating loads and highly variable excess pressures, water level is held within ± 1".

A FEW TYPICAL COMMENTS by FLOWMATIC USERS

No better feedwater regulator could possibly be obtained.
Chief Engineer, Chemical Plant

The water flow follows the steam flow very closely.
Power Eng., State University

No need to "baby" it—gives good results right from the start.
Chief Engineer, Central Station

Never saw any other equipment to compare with it—I like its simplicity.
Plant Engineer, Packing Plant

Without such instantaneous and accurate response of the feed water control valve to constantly changing load and level conditions, it would have been impossible to operate the plant at the high average efficiency of approximately 85 per cent.
Master Mechanic, Rubber Co.

Operation very dependable.
Chief Engineer, Utility Co.

Very stable boiler water level with no more than routine care.
Plant Engineer, Paper Co.

No unit in our plant has operated with less attention.
Chief Engineer, Worsted Mills

We are especially pleased with the ability of these regulators to function at extremely low loads.
Power Engineer, Aircraft Corp.

(Names on request)

HUNDREDS of Central Stations and Industrials with high-duty boilers appreciate what "Flowmatic Protected" means. They know that the Copes Flowmatic keeps feed input always in step with steam output to maintain water level within close, safe limits. They value its simple, sturdy design and independence of other automatics. They need not rely upon experts for installation, adjustment, or operation. To them, "Flowmatic Protected" signifies certainty of feed water control.

Write for Bulletin 435 for the complete story.

NORTHERN EQUIPMENT COMPANY

352 Grove Drive, Erie, Pa.

FEED WATER REGULATORS • PUMP GOVERNORS • LIQUID LEVEL CONTROLS
DIFFERENTIAL VALVES • REDUCING VALVES AND DESUPERHEATERS

Branch Plants in Canada, England — *Representatives Everywhere*

COPES — FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

★ FOR HIGH DUTY BOILERS *Specify* FLOWMATIC ★ REGULATOR

Chart Showing the Correlation of Free CO_2, pH and Alkalinities

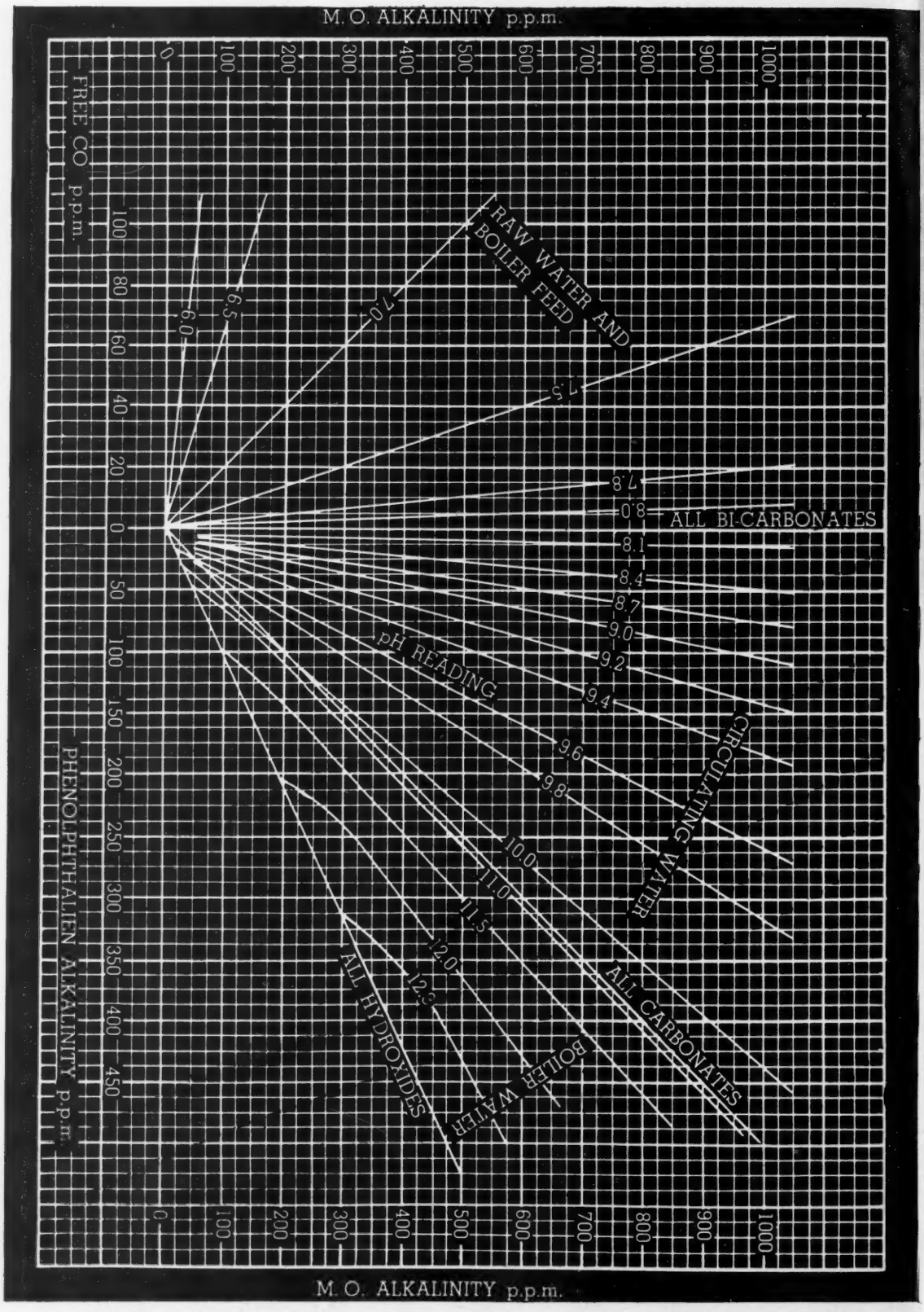
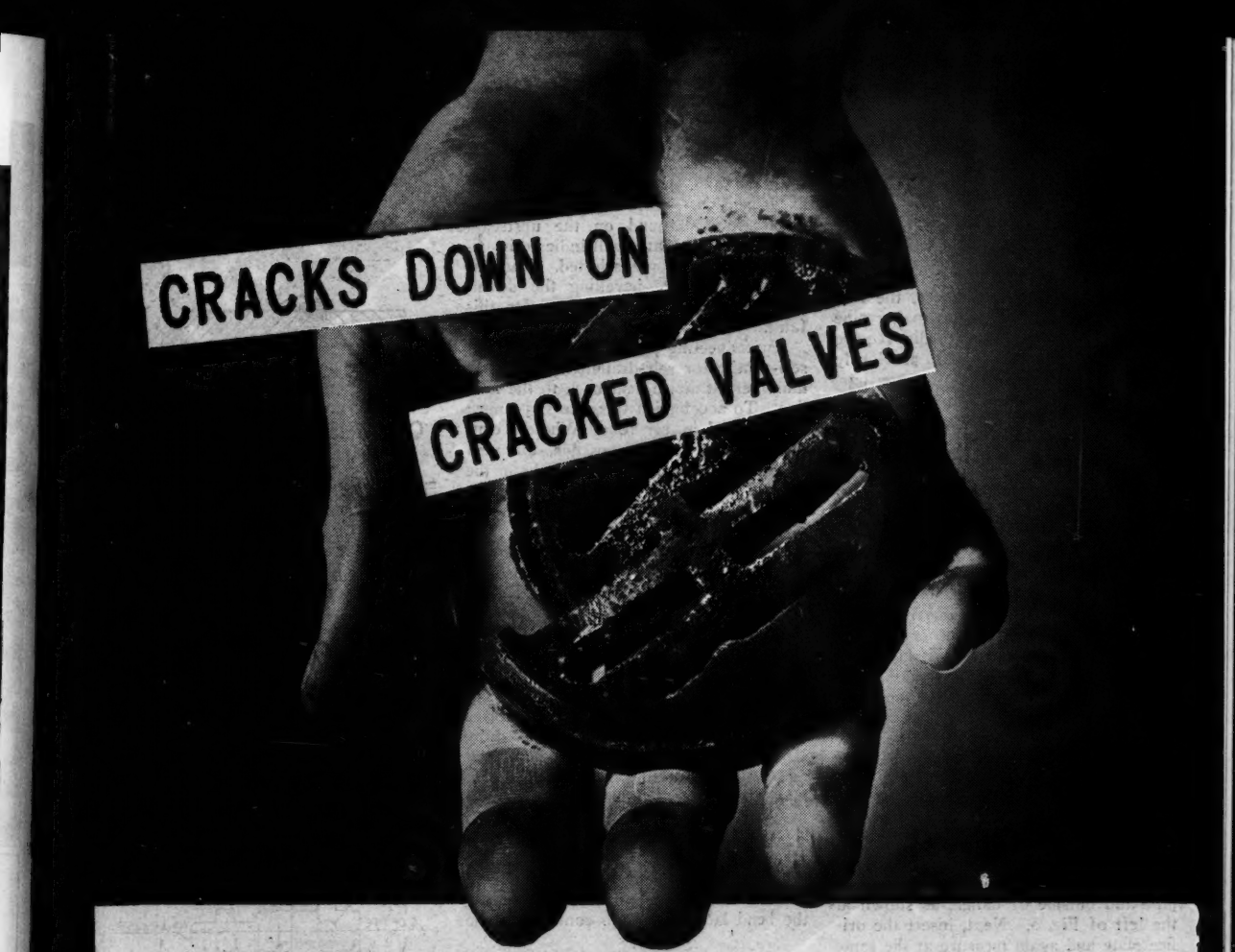


Chart reproduced from "Graver Hot Process Water Softeners" by special permission of the Graver Tank & Mfg. Co., East Chicago, Ind.



SOLNUS OILS . . . eliminate hard carbon

. . . compressor valves last 3 years instead of 1 month

Every overhaul today delays production tomorrow . . . and when it is an important piece of equipment such as an air compressor, reducing shutdowns is a "must."

Hard carbon formed, valves cracked and new ones had to be installed at least once a month on a single-stage, 40 pound compressor in a New Jersey plant. The compressor was "taken down" for cleaning every four months. Then the maintenance men took the advice of a Sun Oil Engineer — a switch was made to Solnus Medium Oil.

Now, valves last for three years instead of cracking and being discarded in one month. Once a year the compressor is checked and cleaned. There is no hard carbon and valves are practically clean.

Reduce shutdowns in your plant by eliminating the unnecessary overhauls that are often caused by faulty lubrication. Solnus Oils, with their high lubricating and wear preventing qualities and Sun Oil Engineering service, offer you a combination proved by hundreds of industrial plants to be the answer to keeping production at its peak. Call in your local Sun Engineer today or write to . . .

SUN OIL COMPANY • ***Philadelphia 3, Pa.***

Sponsors of the Sunoco News Voice of the Air—Lowell Thomas

SUNOCO **SUN INDUSTRIAL PRODUCTS**

OILS FOR AMERICAN INDUSTRY

When Flow Meters Err

(Continued from page 100)

Where the amount of permanent pressure loss is a factor, it can be reduced in several ways. One is to use a larger d/D ratio and a smaller differential. If using a low differential meter, the loss can be decreased by using a smaller pipe size which would automatically require a larger orifice ratio. As previously stated, another method is to use pipe taps if sufficient straight pipe is available to locate the downstream tap.

Installation Factors that Affect Accuracy

Two common errors having to do with incorrect installations are: Reversing the bevel (as shown in Fig. 5) and improper centering. When the bevel is installed on the upstream side it tends to act as a flow nozzle, causing the meter to read low. When a plate is incorrectly installed, the best adjustment is obtained by removing and replacing it correctly. Here, as in many other instances, it is impossible to supply corrective measures for incorrect installation.

If centered improperly the meter may read high or low. When centering the orifice, the convenient measuring point is the outside circumference of the pipe flange. Yet, this is often eccentric to the internal circumference of the pipe. To check possible error, take three equally spaced measurements between inside of pipe and outside of flange, as shown at the left of Fig. 5. Next, insert the orifice plate and again measure at the same locations, between the outer edge of the orifice plate and outside of the flange, as shown at the right. Shift the plate until the difference between the two sets of measurements for each of the three locations is the same. (See figures A — D = B — E = C — F.) The orifice plate will then be centered with the inside circumference of the pipe.

Inaccuracy also results from faulty installation of the taps. Two of the most common incorrect connections are shown in the upper part of Fig. 6 where the nipple projects into the pipe or a burr is left by drilling and tapping. After this installation is completed, it should be carefully inspected.

While a clean, sharp opening is desired, a slight bevelling is permissible. One objection to bevelling, however, is that when filing the pipe wall, it may be roughened. It is practical to weld a half coupling to the pipe. If couplings are not available, a building up of metal, as shown at the right, should be used.

An additional source of error is possible, shown in Fig. 7. A flash or icycle often develops when a welding neck tapped orifice flange is installed. When this type of flange is used the installation should be carefully inspected and the flash knocked off and filed smooth. In order to eliminate this difficulty, many large users are specifying the use of slip-on flanges.

Figure 8 illustrates difficulties to orifice plates that cause a meter to read in error. Fortunately many of these are a rarity. At the top is shown a rounded upstream edge, occurring where water contains sand, or air contains abrasives in suspension. More frequently an accumulation is found on the upstream edge. Warped plates will indicate insufficient thickness was selected. The use of thicker plates, bevelling the downstream edge, will largely eliminate this fault.

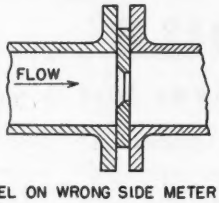
In connecting piping, all pipe must be self-venting or self-draining. The slope must permit air to vent back to the flow line. To accomplish this, the slope must be at least 1 in. per foot. Where a continuous slope is not possible, air vent valves should be installed at peaks in the line. Pockets that allow liquids to accumulate and seal off the line should be avoided.

Trouble resulting in incorrect steam meter readings at or near zero can sometimes be traced to condensers. This is shown by Fig. 9. The error may be considerable at the lower part of the scale. On a meter having a 50 in. H_2O full scale range, condensers out of level 1 in. will cause the meter to read 10 per cent of full scale under no flow conditions. Condensers out of level are caused by improper installation or subsequent damage. Unsupported connecting piping may also cause trouble for its weight may cause the orifice nipples to bend.

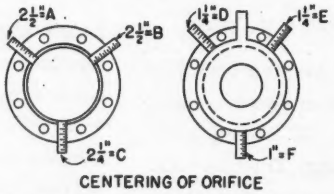
Trouble will occur when a bent nipple fills with water, shown in Fig. 10. The internal diameter may be too small to allow condensate to drain back because the bend lacks a smooth contour, or the internal surface of the nipple is rough. When the nipple fills with water, head h' cancels an equivalent head h in the connecting line to the meter body and at zero flow. Equal pressures are no longer applied to both legs of the manometer and the meter will read far above or below zero. When the meter is then in operation, h' for an 8 in. line may be equivalent to the sum of the high and low pressure tap distances and may be as much as 10 to 12 in. of water.

To eliminate the difficulty (if there is no kink in the bend) lag the nipple to prevent excessive condensation. Lagging the ½ in. extra heavy pipe size nipple will not always eliminate the difficulty, and it will be necessary to use ¾ in. pipe. If a larger diameter nipple is required the opening through the pipe wall should be increased to avoid a dam. Use of seamless steel tubing for bent nipples will avoid roughness to which particles of water might cling.

In measuring hot water in a vertical line, as shown by Fig 11, that is at temperatures about 125 F., errors will occur if the temperature of the water



BEVEL ON WRONG SIDE METER LOW



CENTERING OF ORIFICE

Fig. 5. Meter accuracy requires correct orifice installation

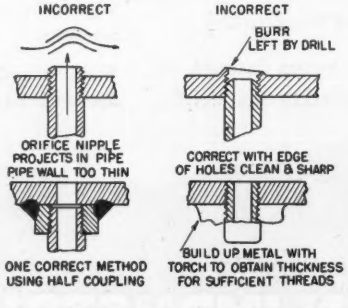

INCORRECT
INCORRECT
BURR LEFT BY DRILL
ORIFICE NIPPLE PROJECTS IN PIPE PIPE WALL TOO THIN
CORRECT WITH EDGE OF HOLES CLEAN & SHARP
ONE CORRECT METHOD USING HALF COUPLING
BUILD UP METAL WITH TORCH TO OBTAIN THICKNESS FOR SUFFICIENT THREADS

Fig. 6. Orifice nipple connections are common causes of erroneous readings

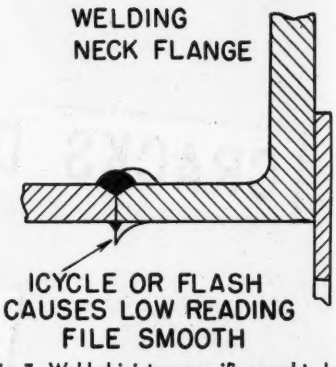


Fig. 7. Welded joints near orifice need to be carefully inspected on the inner surface

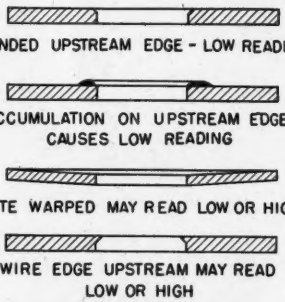

ROUNDED UPSTREAM EDGE - LOW READING
ACCUMULATION ON UPSTREAM EDGE CAUSES LOW READING
PLATE WARPED MAY READ LOW OR HIGH
WIRE EDGE UPSTREAM MAY READ LOW OR HIGH

Fig. 8. Common causes of error

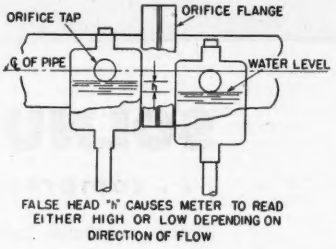
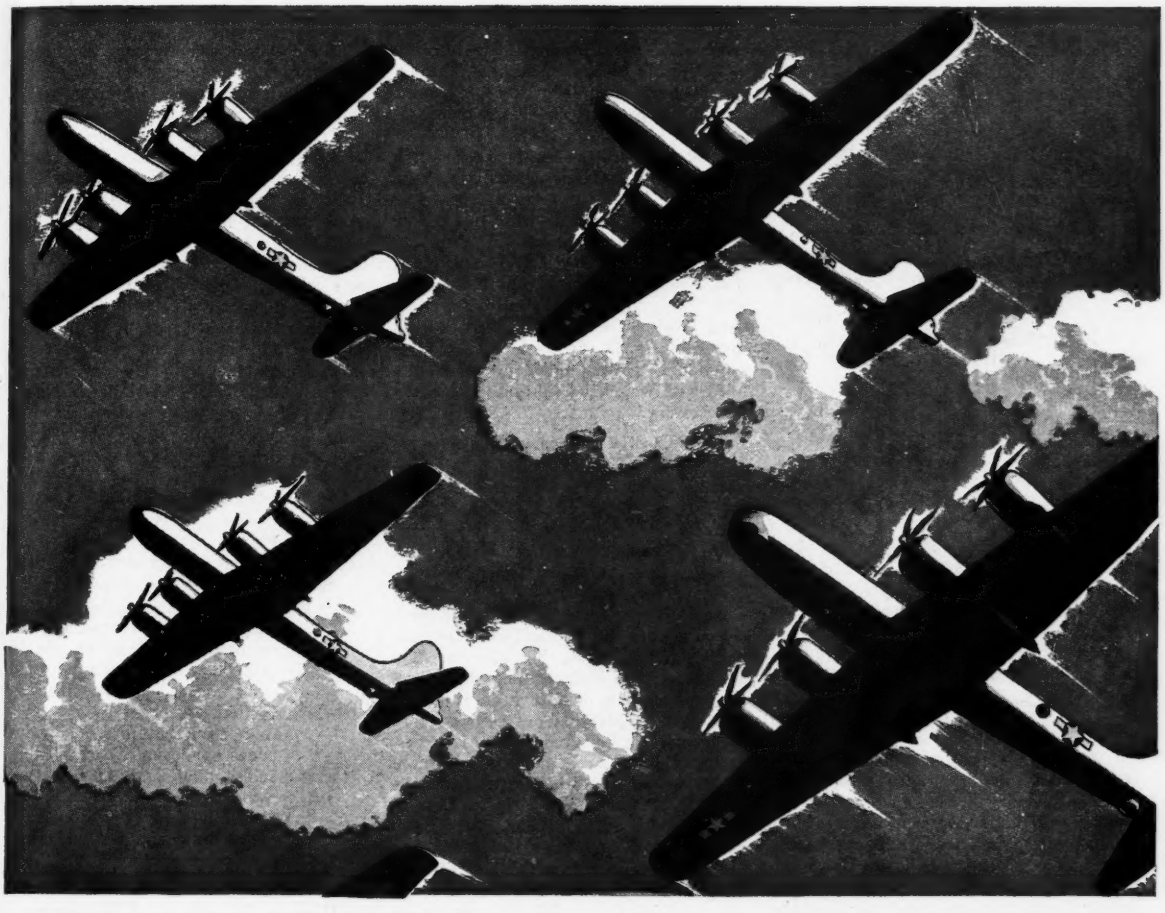

ORIFICE TAP
ORIFICE FLANGE
℄ OF PIPE
WATER LEVEL
FALSE HEAD "h" CAUSES METER TO READ EITHER HIGH OR LOW DEPENDING ON DIRECTION OF FLOW

Fig. 9. Error in reading is caused by condensers not being level



Closely knit for greater strength

WHEN highest quality seamless steel tubing is forged into Tube-Turn welding fittings by Tube Turns' exclusive process, here is what happens: Molecules are redistributed, resulting in a closer-grained metal—a more closely knit structure that actually possesses far greater strength than before.

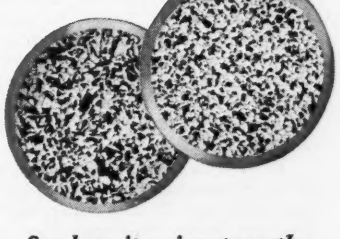
This increased strength is of vast importance to industry, because it means greater safety at points of greatest strain, where flow changes direction. It also means longer life for the entire piping system. Other advantages offered by Tube-Turn welding fittings over other fitting types include lighter weight, easier installation, lower maintenance cost, greater efficiency of flow, greater flexibility of layout, less space required, easier insulation.

For complete information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for Catalog 111.

• • •

Selected Tube Turns Distributors in every principal city are ready to serve you from complete stocks.

TUBE TURNS (Inc.), Louisville, Kentucky. *Branch Offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle, Los Angeles.



See how it gains strength

These microphotographs of the grain structure of metal used for Tube Turns before and after forging clearly show the closer-knit structure which gives finished Tube-Turn fittings added strength.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*

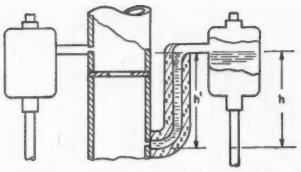

h'
h
HEAD OF WATER h' CANCELS h IN METER LINE
CAUSING HIGH OR LOW READING DEPENDING
ON DIRECTION OF FLOW
TO CORRECT LAG LINE AS SHOWN

Fig. 10. Bent nipple filled with water on vertical steam flow lines causes false reading

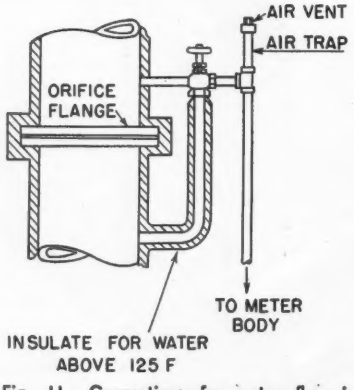


Fig. 11. Connections for water flow in vertical lines

in the bent nipple is not kept somewhat near that of the water in the flow line.

The meter will read in error if the temperature of the water in the bent nipple is not maintained at approximately the same temperature as in the flow line. This can be done by lagging the bent nipple, important on installations where condensers are installed at the lower tap level and the bent nipple extends downward.

Figure 12 illustrates another application where trouble often occurs. When measuring steam with the meter above the flow line, it should be possible, theoretically, to locate the meter any reasonable distance above the line, as shown. The connecting piping should be filled with steam only and any condensate should drain back to the flow line.

Even with use of risers made of ¾ in. or, in some cases even 1 in. pipe lines, the piping will fill with water and cause incorrect meter readings. The reason for incorrect readings is the same as in the case of bent nipples. Both cause incorrect pressure to one side of the meter body.

Make certain the lines are completely filled with water. In this installation, condensate forms when steam is turned into the lines. It drains down into the U trap. Condensation will continue until the entire lines are filled with water. It is held at the trap by the steam pressure. Provision can be made to trap air which may rise in the line at a point above the connection to the meter body. Unless the quantity of air becomes so great that air space extends below the opening of the pipe to the meter body, pressure changes will be transmitted correctly to the mercury surface. However, should the air space extend below the opening, pressure changes will not be transmitted correctly to the mercury surface because the air is an elastic medium. The air should be vented at intervals frequent enough to prevent the latter from occurring.

The extension of the pipe below the condenser is very important. If the steam line is shut down and opened to atmosphere, water will drain out of the vertical lines and would be displaced with air if traps are not installed. It will then be necessary to vent the lines when they are again placed under pressure. With the U trap, installed as shown in Fig. 12, air is sealed off. When the line is placed under pressure it is filled with water and venting is generally unnecessary.

Difficulties with Meter Bodies

In order to obtain satisfactory operation, a certain amount of meter body maintenance is required. This consists of keeping interior surfaces clean, seeing that the meter contains the correct amount of mercury and is free from air. Many plants maintain a schedule of maintenance operations. Periodic zero checking and making of water column checks are essential, but the necessity for dismantling and cleaning should not be done until a definite need is shown by sluggish operation or the results of water column test indicate it is necessary. There are many applications where actual operating experiences determine the time for periodic cleaning and in those cases it should be done at regular intervals.

What occurs when the low pressure range tube becomes coated and decreases its area? Refer to Fig. 13. Let us assume the flow meter is a controller and the control point is 80 per cent of full scale. With a clean meter body, the float will assume the position as shown at the left and the rise in mercury will be h. If the range tube walls become dirty, decreasing the effective area, the height of the column must increase to h' with the float in the same position as when the meter body is clean.

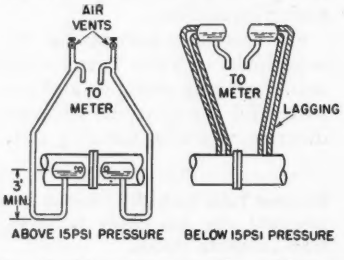


Fig. 12. Measuring steam flow with meter above line

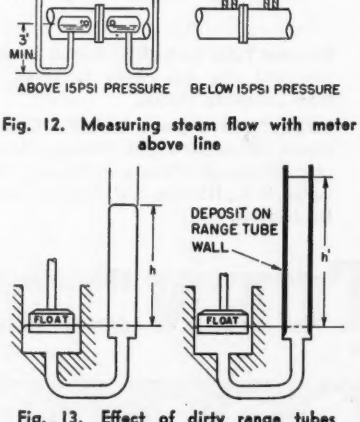


Fig. 13. Effect of dirty range tubes Regenerative Air Heaters

In meters where the square root is extracted by the shape of the range tube, the zero level is very important since there is a definite starting point. The exact amount of mercury required is generally stamped on a plate fixed to the meter body. Changes in mechanical adjustments, to make the meter read correctly at zero, should be made by checking the mercury column.

In many mechanical and electric meters using straight walled mercury chambers some variations in mercury level can be compensated for by either mechanical adjustments that are provided in the instrument linkage or by shifting the coil position. Corrections should be held at a minimum to avoid loss in mercury and prevent the level becoming so low that full scale float travel cannot be obtained.

Incorrect maintenance of the pressure tight shaft often occurs with mechanical meters. This is more prevalent where there is a lack of trained instrument men.

Some major rules to remember are:—

(1) Keep meter body level.

(2) Check the zero frequently; the elapsed time between checks will vary with the application and must be determined in actual practice.

(3) Make sure the cross over valve does not leak. To check this, close h.p. and l.p. shut-off valves when the meter is registering flow. If equalizing valve leaks the pen will move.

Simplified Practice for Pipes, Ducts and Fittings

THE NATIONAL Bureau of Standards has recently approved for promulgation a simplified practice recommendation for pipes, ducts, and fittings for warm air heating and air conditioning. It will be effective from March 1, 1945, and will be identified as "R207-45."

This recommendation is an outgrowth of study given the subject by a simplification committee of the industry over a period of several years and sets up a stock list of pipes, ducts, and fittings representing the best thought of the industry.

Fittings for both gravity and forced air heating and air conditioning systems are covered, the former including double-wall pipe and fittings. Sketches illustrate the 91 types of fittings, various sizes of which are included in the list, as well as the recommendations as to which items are to be carried in galvanized iron of various gages, and which in tin.

There is a total of about 1223 items in the list, whereas at least one large producer has recently cataloged not less than 5580 varieties of pipes, ducts, and fittings for the same types of installations covered by the recommendation. On the basis of information submitted by manufacturers when the division was cooperating with the War Production Board on this subject, it is estimated that the recommendation will effect a reduction of inventory of about 40 per cent.

PREVENTION

THE BEST SAFEGUARD

BIRD-ARCHER

Experience and Service will safeguard your boiler system and processes against the damage that can be caused by corrosion, scale, carryover, embrittlement. We offer

outstanding—modern—complete service in

INDUSTRIAL WATER CONDITIONING

based upon 60 years cumulative experience. Write for our latest booklet on Water Testing Equipment for Power Plants and Methods of Procedure.

Consultation, without obligation

THE BIRD-ARCHER CO.

NEW YORK 17, N. Y. • CHICAGO 11, ILL. • PHILADELPHIA 40, PA. • MONTREAL, CAN.

SURVEYS • PLANT STUDIES • CONSULTATIONS • TREATMENTS
PLANT DESIGN • SUPERVISORY SERVICE • LABORATORY SERVICE

Possibilities of the
Pressurized Boiler Furnace

Overall efficiencies of boiler furnaces employed in present practice have about reached practical limits—Further lowering of final flue gas temperature not likely—Developments indicate possibilities of smaller furnaces and reduced weights of metals in boilers, through higher rates of combustion in pressurized furnaces and forced boiler water circulation — Lower first cost of complete unit a possibility

By A. G. Christie *Professor of Mechanical Engineering The Johns Hopkins University, Baltimore, Md.*

REMARKABLE changes have taken place in the design of boiler furnaces during the last 40 yr. If these are analyzed one will find continual advances in capacity to burn fuel and in efficiency of combustion. Furnaces of any desired capacity at or about atmospheric pressure, can now be built. Overall efficiency of the steam generating unit is principally fixed by the per cent of excess air admitted and by the allowable flue gas temperature leaving the air preheater.

Until some means are developed that will enable this temperature to be lowered without causing undue corrosion of metal parts, such for instance as the use of stainless steel parts in preheaters, there appears to be little possibility of increasing the overall effciency much beyond present figures.

On the other hand, there appear to be opportunities for reducing furnace volumes and for designing heating surfaces that will be capable of greater rates of heat transfer than at present. The possibilities of the pressurized furnace for achieving these ends will be considered in the following paragraphs.

In their early development, furnaces serving boilers were brick lined and provided with stationary grates. Later conditions were improved by the use of shaker grates and mechanical stokers. Some of the types employed were overfeed, V-shaped Dutch oven, traveling grate, underfeed and spreader. All of these types are employed today with improvements which enable modern efficiencies.

Powdered coal furnaces serving steam boilers came into use following their successful application in the portland cement industry, and have undergone many improvements until today they stand in the first rank of efficiency.

Water cooling of furnace walls was employed in early designs of locomotives, small vertical boilers, large boilers of the Manning type and the Morrison furnace of Scotch marine boilers. Many new forms of water-wall construction have been developed as improvements in pulverized coal furnaces.

The Next Step

Since there are practical limitations upon further lowering of final flue gas temperatures below present practice, relatively small gains can be made in overall steam generator efficiency. On the other hand, the large furnaces now in use require boiler rooms of large volume and consequently of costly construction. Weights of metal in the boiler itself have become large as higher pressures have come into use. Also, auxiliary power requirements are large for forced and induced draft fans. What steps can be taken to develop a smaller steam generator of less weight but equal or better efficiency?

One attempt to achieve this end was the introduction of the forced circulation boiler. This enabled the designer to use smaller boiler tubes and thus to reduce weight. Forced circulation boilers are in successful operation both here and abroad. It is recognized that higher water velocities in the boiler tubes tends to increase heat transfer rates. However, this has not led to any great decrease in furnace volumes.

Smaller furnace volumes require greater heat releases per cubic foot than is standard practice, if the same amount of steam is to be produced. This requires more rapid ignition and more complete combustion in a given furnace space. There appears to be a limit to the turbulence that may be obtained in standard furnaces although experiments are being made on new furnace forms that promise increased turbulence.

Experiences abroad with the Velox boiler and with the gas turbine in this country has indicated that there may be possibilities of smaller furnace volumes as a result of the maintenance of pressures of several atmospheres in the furnace. The possibilities of such pressurized furnaces need to be considered as a possible further step in steam generator development.

The Pressurized Furnace

The closed stokehold method of firing used on some ships might be considered as an early example of combustion under pressure conditions. In this system, the forced draft blower delivered air under pressure into the closed stokehold. This air passed through the grates, combined with the fuel, and as flue gases, passed out the stack, all under pressures slightly above atmospheric. There may be some question whether there was a positive pressure in the furnace above the fuel bed. In any case, the pressure was not large and does not seem to have any great influence on either the rates of combustion or of heat transfer. The closed stokehold thus appears to have been merely a plenum chamber for the forced draft air.

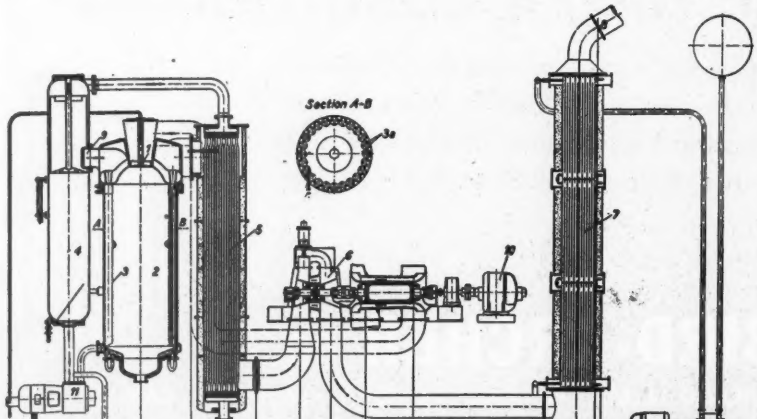
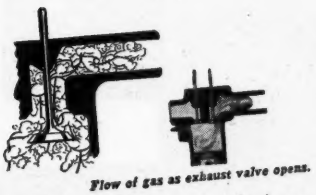


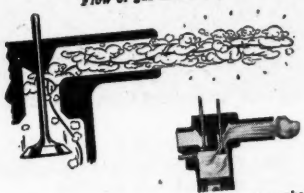
Fig. 1. Schematic diagram of Velox steam generator. 1. Burner. 2. Combustion chamber. 3. Evaporator tubes. 3a. Internal tubes. 4. Separator. 5. Superheater. 6. Gas Turbine. 7. Feedwater heater. 8. Exhaust pipe. 9. Separator entrance. 10. Auxiliary motor. 11. Circulating pump. 12. Feed pump.

BURGESS SNUBBER BULLETIN for Diesel Exhaust Noise Control

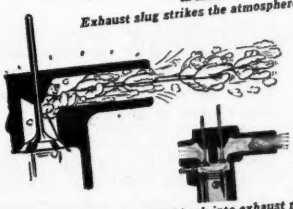
HOW REVERSE FLOW OF EXHAUST GASES CAUSES NOISE AND INCOMPLETE SCAVENGING



Flow of gas as exhaust valve opens.



Exhaust slug strikes the atmosphere.



Burned gases sucked back into exhaust pipe.

While engineers usually think of exhaust gases as flowing in an outward direction only, the truth is that there is a two-way flow when no Snubber is used to check it. There is a surge outward every time an exhaust valve opens, then a considerable reverse flow of gas back toward the cylinder after the cylinder has been emptied. The violent oscillation of the exhaust gases has been drawn in cartoon form. At the right of each cartoon is a picture of this gas movement as it actually takes place during a portion of the engine cycle.

The first picture shows how the gases surge out of the exhaust port as soon as the valve opens. Because of the extremely high pressure within the cylinder, these gases are accelerated very rapidly and shoot out of the exhaust pipe with great force. The main body of gases, traveling at high velocity and under high pressure, is known as the exhaust "slug." The action as the "slug" leaves the exhaust pipe is shown in the second drawing. Most of the gases shoot out of the exhaust pipe and very little gas is left in the cylinder. The result is that a relatively high vacuum is created in the cylinder and in the exhaust line close to the valve.

When this vacuum has become great enough to overcome the momentum of the slug, exhaust gases, together with some air around the end of the exhaust pipe, are sucked back into the pipe. If this occurs during the period the exhaust valve remains open, the cylinder will again be filled with burnt gases. Thus, on a two-cycle engine it might be found that the supply of fresh air is contaminated with burnt gases and the engine would be inefficient or might fail to run.

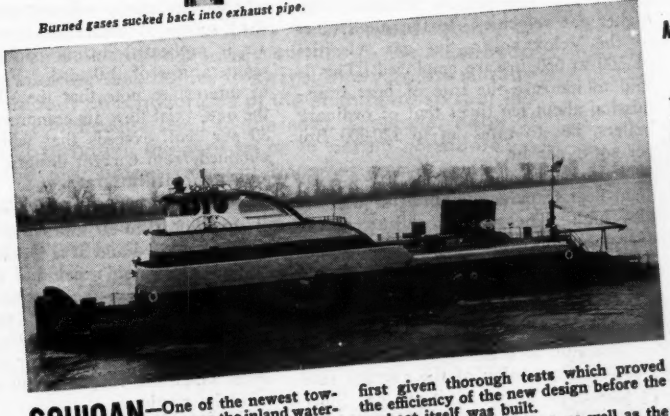
Noise Caused by Two-Way Flow

This two-way flow takes place in any exhaust pipe not equipped with a Snubber. It explains the difficulty of obtaining adequate silencing with old style "mufflers." Such devices do not prevent the reverse flow, and it is necessary to tune the exhaust system so that the reverse flow will not interfere with efficient engine operation.

No tuning is necessary where a Burgess Snubber is installed. The exhaust slug is "snubbed"—that is, it is slowed down and dispersed—so that there is no reverse flow to cause trouble and incomplete scavenging. Exhaust gases leave the tail pipe of the Snubber in a quiet, even flow.

This two-way flow of gases is also responsible for a large part of the exhaust noise. Exhaust gases, passing down the pipe as each slug leaves the engine, strike the atmosphere making a sharp sound similar to that of a toy pop gun. This is followed by oscillation in the pipe line causing a low pitched roar. Thus, "snubbing" the exhaust slug eliminates the cause of exhaust noise, stopping both the "pop" of the outward flow and the accompanying roar.

★ ★ ★



SOHIOAN—One of the newest towboats on the inland waterways and, undoubtedly, the most modern and streamlined in the country, is the Standard Oil Company of Ohio's "Sohioan." In addition, it is the most powerful Diesel towboat on the river, having three Fairbanks-Morse Diesel engines, each developing 805 hp. at 300 rpm.

Since the "Sohioan" incorporates a number of new design features to obtain the greatest amount of power that is practicable in an engine hull, a 10-ft. model was first given thorough tests which proved the efficiency of the new design before the towboat itself was built.

The interior of the boat, as well as the engineering construction, is as modern as its appearance with top quality equipment used throughout. In order to assure crew comfort, the engine room ceiling is covered with fireproof acoustic panels and acoustic blanket to minimize engine noise, and all three main engines are equipped with Burgess Snubbers to eliminate exhaust noise nuisance.

HELPFUL HINTS

Avoid the use of flat-sided or thin-walled conduit for exhaust gases

The seemingly unimportant question of what kind of pipe to use to carry exhaust gases from the engine to the Snubber is really a big factor in quiet operation, in order to be sure that vibration and noise are not caused by the wrong kind of pipe. Where the wrong kind of pipe is used, the Snubber is sometimes blamed for noise which is really "pipe noise."

Flat-sided conduits, for example, should never be used. The sides of such rectangular pipes, even when they may seem heavy or rigid, vibrate like diaphragms in tune with the oscillation of the exhaust gases. Not only does this vibration cause "pipe noise," but it may become extreme enough to cause joints to open or the pipe itself to fail in service.

Spiral-welded pipe, or any other pipe which has thin walls, should be avoided when used for exhaust pipe. Such a pipe will "talk" or "sing," causing a great deal of noise which can be completely avoided by using heavier pipe. Once exhaust gases pass through the Snubber, however, their flow is smoothed sufficiently so that any pipe of sufficient mechanical strength can be safely used for a tail pipe.

Published by BURGESS-MANNING COMPANY Chicago, Illinois

COPYRIGHT 1945—BURGESS-MANNING COMPANY

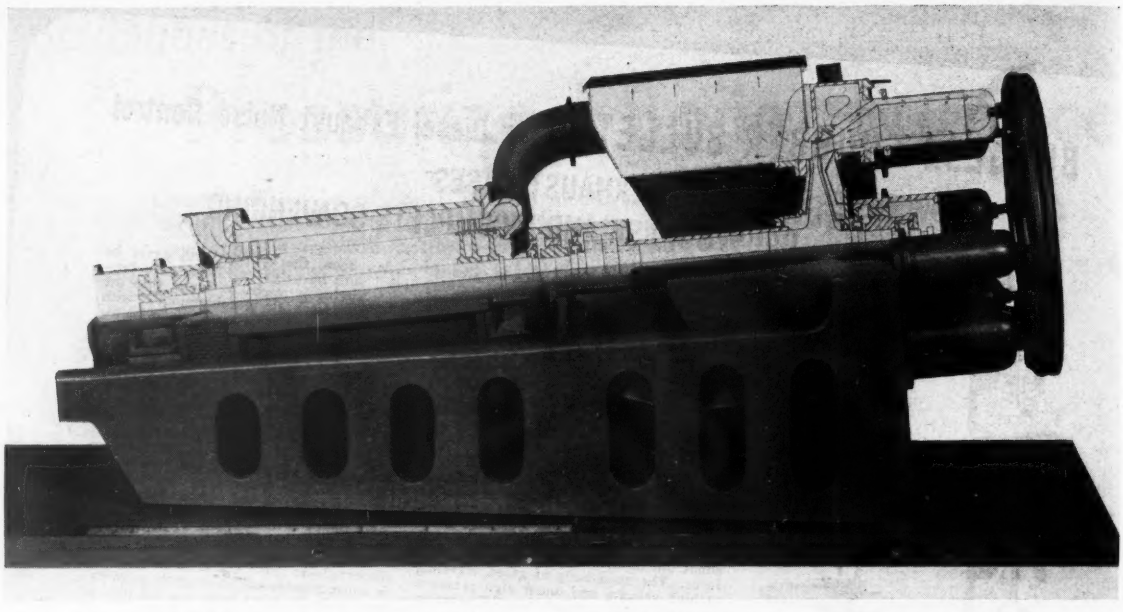


Fig. 2. Cutaway model of pressurized furnace as applied to gas turbine by General Electric Co. From left to right: Axial-flow compressor, crossover, ducts to combustion chambers, turbine exhaust, turbine, combustion chambers, fuel manifold

Some years ago the late F. W. Wood of Baltimore, formerly President of the Maryland Steel Co., explained to the writer some ideas which he entertained in reference to a boiler furnace in which combustion would take place under pressures up to 25 psi. Based on some experience or reasoning that Mr. Wood did not divulge, he had reached the conclusion that this method would justify an investigation. The means to this end, the air compressor necessary, its probable power requirements and possible furnace designs, were discussed. Mr. Wood proposed to carry out some experimental work on this idea but other matters intervened and the writer never heard of any actual tests.

Some years later, Dr. Adolph Meyer of Brown Boveri & Co., Baden, Switzerland, announced the development of the Velox boiler by his Company. This has been frequently described since in the technical press and a considerable number of such boilers are in service abroad. Dr. Meyer described this unit in his paper before the American Society of Mechanical Engineers in 1935, entitled The Velox Steam Generator, which is printed in Mechanical Engineering, August, 1935, page 469.

The Velox Boiler

The Velox boiler operates with gas or oil as fuel. When oil is used, it is delivered to the mechanical burners at about 300 psig. The air supply to this chamber is compressed in an axial flow compressor driven by a gas turbine. The cylindrical combustion chamber is surrounded by a row of closely spaced evaporating tubes through which boiler water flows by forced circulation. Each water tube contains a bundle of three or more small tubes for the passage of the hot gases and these tubes form the convection surfaces of the boiler. The entrances of the small gas tubes are of well-rounded nozzle forms and the outlet ends are provided with elongated diffusers to convert the leaving gas velocity head into pressure.

Normal flue gas velocities in the convection portions of standard boilers seldom exceed 40 to 50 fps. Many years ago, Prof. Nicholson demonstrated at Manchester, England, that increased heat transfer rates would be obtained with higher gas velocities. In the small tubes of the Velox boiler, flue gas velocities of 500 to 650 fps are employed. This is said to increase the rate of heat transmission about ten times that of ordinary boilers, i.e., to rates up to 120,000 Btu per sq ft per hr.

In the furnace itself the rate of radiant heat transfer to the water walls is also high. The rates of heat transfer average about 110,000 Btu per sq ft per hr over the whole heating surfaces of the boiler and thus result in greatly decreased heat absorbing areas and hence, in relatively small boilers.

This rate of heat absorption is equivalent to evaporation at the average rate of about 100 lb per sq ft per hr. Since there is no ash to cause trouble with oil fuel, heat liberation rates in the furnace may be as high as 900,000 Btu per cu ft per hr, due to the rapidity of combustion in the compressed mixture. This permits the use of relatively small furnace volumes.

There is a pressure drop of a few pounds per sq in. in the small convection tubes from which the gases issue at normal load at about 1500 F, and enter the superheater. High gas velocities of about 330 fps are provided in the superheater with a further small pressure drop and reduced superheating surfaces.

The gases leave the superheater at about 30 psig, 900 F, and enter a gas turbine of the reaction type, which drives an axial flow air compressor and a small electric generator. The gases exhaust from the turbine at about 2 psig and then pass through a feed water economizer section before being released to atmosphere at about 300 F.

The energy absorbed from the flue gases by the gas turbine is transferred to the driven axial flow air compressor where it is largely returned to the air in the process of compression so that the air is preheated during compression to temperatures of 250 to 350 F. It is also of interest to note that the efficiency of the new axial flow air compressors about 80 per cent, exceeds that which can be obtained from current designs of forced and induced draft fans.

Forced circulation of the boiler water at rates of 10 to 20 times the weight of steam generated and at a speed of 20 fps in the tubes is so rapid that practically no scale forms on the heating surfaces. Centrifugal separation of water and steam occurs in a vertical chamber adjacent to the steam generator proper and from which the forced circulation pump takes its suction.

All auxiliary power is furnished by the gas turbine which drives besides the air compressor a small auxiliary generator that may serve also as a starting motor. Hence, no auxiliary power for fans or forced circulation pump must be supplied from the gross output of the main steam turbine.

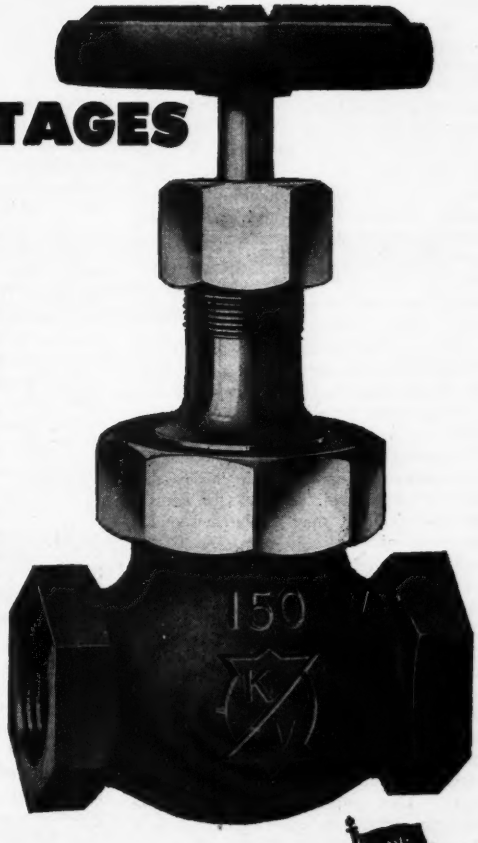
The reduction in furnace volume and heating surfaces results in a small steam generator and consequently in greatly reduced boiler room volumes. A Velox set with auxiliaries to deliver 120,000 lb per hr of steam is said to occupy 300 sq ft of floor space and to require about 30 ft of head room. Its total weight with auxiliaries is given as about 120 tons.

The efficiency of the Velox boiler is naturally fixed by the final flue gas tem-

"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

You wouldn't think a DISC HOLDER could have so many ADVANTAGES



The disc holders in these Kennedy 150 lb. renewable composition disc bronze globe and angle valves are literally crowded with special features and advantages.

To begin with, four guide prongs are provided to guide the disc holder accurately in the body and prevent tipping or binding. A smooth milled bearing surface in the stem-head recess permits the disc holder to swivel freely on the slightly rounded smooth bottom surface of the stem head so that the disc can accommodate itself to the seat. The outer edge of the holder overhangs the seat so as to permit considerable wear of the disc before renewal becomes necessary.

Then, additional features assist convenience of disc renewal. The holder locks itself positively in place on the stem at a definite position, wide open, so that it cannot fall off when the valve is taken apart. This arrangement protects the disc from damage and prevents the holder from interfering with reassembly of the valve. Once the stem and disc holder assembly is removed from the valve, a mere half-turn of the stem releases the holder and permits it to drop off.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

KENNEDY *valves... pipe fittings... fire hydrants*

perature leaving the economizer and by the amount of excess air furnished. Tests have shown efficiencies with fuel oil in the neighborhood of 88 to 90 per cent based on the higher heat value of the fuel. While there are many Velox boilers in use abroad, to the writer's knowledge, none are in service in the United States.

Other High Pressure Furnaces

The success of the gas turbines used with the Velox boilers led to the development of larger units independent of any boiler. The hot gas for the turbine is obtained by further heating the air compressed in the axial flow compressor by burning fuel oil or gas in a special combustion chamber placed between compressor and turbine. This combustion chamber is under the pressure of the compressed air at about 50 psig. The largest unit of this type is a 4000 kw gas turbine generator set in commercial operation on fuel oil in a Swiss city. Descriptions and tests of this unit have appeared in the technical press.

In this country Allis-Chalmers Manufacturing Co. has supplied a considerable number of gas turbine sets for operation in connection with the Houdry process of petroleum refining. The turbines receive hot gases from the catalytic towers and in some cases the heat of these gases is increased by burning fuel oil or gas in chambers placed between catalytic tower and gas turbine throttle. Several gas turbine sets to operate on fuel oil in power plants and built by several builders, are said to be under construction or starting in operation in this country.

A valuable discussion of pressurized combustion is presented in a paper, Firing High-Pressure Furnaces, by E. G. Peterson and published in "Transactions" A. S. M. E., July, 1944, page 433. The author describes combustion chambers used in connection with the Houdry process where fuel oil or gas or combinations of these, may be burned under pressures of 45 to 55 psig. He states that many such direct fired air heaters are now in service with furnace loadings of 500,000 to 2,500,000 Btu per cu ft of furnace volume. These rates exceed those stated above for the Velox boiler furnaces and their use in steam boiler operation would still further reduce furnace volume. The types and operating characteristics of the burners in use and the construction of these special combustion chambers are described in the paper. This paper indicates that the problem of burning gas or fuel oil in a pressured furnace has been studied and satisfactory commercial burners and controls are already available for such services.

An Analysis of the Pressurized Furnace

Let us examine the outstanding characteristics of the Velox boiler and gas turbine combustion chambers and note the effect of these on heat transfer and boiler size. Among these features are forced circulation of boiler water, combustion under pressure and forced circulation of convection flue gases.

Forced circulation of boiler water is a characteristic of other boiler designs than the Velox. For example, it is used in the Benson, the LaMont and in boilers built by Combustion Engineering Co. in this country. Satisfactory circulating pumps have been developed and experience is accumulating on features of operation. It can be said that forced circulation is an established practice and is no longer a novelty. By its use smaller and therefore less heavy tubes can be used than otherwise and forced circulation provides ample water to all tubes. High water velocities in the tubes sweep the steam bubbles off the surfaces as rapidly as formed thus lessening the possibility of scale formation and at the same time, permitting high rates of heat transfer.

Combustion under pressures greater than atmosphere is characteristic of fuel burning conditions in gasoline and Diesel engines. It is well known and proven by test, that ignition takes place at a very much greater speed in compressed air than under normal non-pressure conditions and also that combustion is generally more rapid and more complete. Hence, in applying pressure conditions to a boiler furnace one is simply following internal combustion engine practice. Due to pressure, there are more pounds of air and fuel per cu ft of furnace volume than under atmospheric conditions. This density combined with the rapidity of combustion leads to the high rates of heat release found in the Velox boiler and in gas turbine combustion chambers. Also, the greater density of the gases in the pressurized furnace combined with the high turbulence caused by rapid combustion leads to increased rates of heat transfer to the water-cooled furnace walls by the combined effect of radiant heat and convection.

Forced gas circulation obtained by increased gas velocities from a pressure drop in the convection tubes is simply an extension of the principles advanced by Nicholson. The unique feature of the Velox boiler is the production of velocity at the convection tube inlet by properly formed, rounded nozzle inlets and the reconversion of velocity head into pressure at the discharge end by means of diffusers. The gas convection tube is virtually an elongated Venturi meter.

The Velox boiler and gas turbines have demonstrated the advantages of pressurized combustion when gas or oil are the fuels. Can pressurized combustion be applied to coal fired furnaces, and if so, can any advantages be gained over present steam generator designs?

Due to the greater density of the air and gases in the pressurized furnace, one could expect more rapid combustion of coal particles to occur than in a furnace under atmospheric pressure. The real problem arises when one considers the physical construction of a large furnace to burn pulverized coal, as there is an ash problem not existent in the oil fired furnace. For structural reasons this pressurized furnace would probably have to be circular in form. Due to the high rate of heat liberation the ash would tend to remain liquid, hence a wet bottom furnace may be necessary. The problem of discharging the ash in either liquid or dry state, from this furnace would present some difficulties. Outside of the ash removal problem, it would seem feasible to design a pressurized furnace itself with entirely water-cooled furnace walls to burn pulverized coal.

The design of the convection portion to utilize high gas velocities would be more difficult. Very small gas tubes as used in the Velox would not be practical as these would slag-up rapidly and could not be readily cleaned. If one assumes that the furnace gases are cooled below the sticky temperature of the ash before admission to the convection tubes, the erosive action of the solid ash particles at high velocities on the tube surfaces would have to be considered. This portion of the steam generator design will require the utmost ingenuity of the designer.

Ash particles would have to be removed from the flue gases before admission to the gas turbine if such is used to drive the compressor which furnishes the air supply. This may require centrifugal or electrostatic dust catchers or both, and these must function at high temperatures. There would also be the problem of removing the separated fine ash particles from the hoppers of these dust catchers as these hoppers would also be under pressure.

Finally, means must be developed to feed powdered coal into the pressurized furnace and of providing proper mixing burners and controls.

With these considerations in mind, what are the possibilities of the pressurized boiler furnace? One may summarize factors in its favor as less floor space and building volume, less metal required in boiler construction and possibly a lower first cost of complete unit. One compressor takes the place of both forced and induced draft fans. Power for auxiliaries is obtained from the waste flue gases by means of a gas turbine which would increase the net output of the main steam turbine. On the other hand, there would be little if any increase in steam generator efficiency. Also, there are numerous difficult construction problems to solve particularly when coal is used as fuel. The possible gains in smaller and less costly boiler rooms would seem to warrant the trial of pressurized boiler furnaces.

THE RESISTANCE WELDING MANUFACTURERS ASSOCIATION has inaugurated a program of co-operative educational activity on resistance welding subject. The main objective of the educational program will be to encourage and to assist in the expanded use of resistance welding by making more widely available a knowledge of the advances in design, in welding techniques and in fabricating procedures.

Essentially this program is a continuation of established activities of the Association in sponsoring research projects, co-operating with interested engineering societies and developing equipment standards and recommended practices.

ask yourself THESE QUESTIONS

Before Selecting a Piping Contractor

"Has he had extensive experience on jobs like mine?"

MIDWEST organization has erected piping for more than four decades and in that time has handled every type of piping job. Whether you have a power plant . . . a chemical or process plant . . . or whatever your piping needs may be Midwest offers you a wealth of experience on comparable jobs.

"Does his fabricating plant have all the facilities needed?"

MIDWEST has four modern pipe fabricating plants. Each is equipped for any kind of piping job: layout tables . . . bending equipment . . . work rotating fixtures for welding . . . special lap-forging machines . . . etc. You will find no better equipped pipe fabricating plants.

"Is his location convenient?"

MIDWEST plants are strategically located to give quick service to any part of the country. Each plant is a complete unit but they work together on large jobs where time limitations do not permit all fabrication in one plant.

"Are his organization and erecting facilities adequate?"

MIDWEST places a resident engineer with a permanent staff of supervising erectors on the job. All Midwest qualification welders are from our own shop organizations. Midwest carefully controls the flow of materials from drawing board to the complete installation.

"Has he kept abreast of recent piping developments?"

MIDWEST has done more than that . . . among Midwest developments are the Globack joint which greatly improved lapped joints, the Midwest saddle for better reinforcing branch outlets, and a complete line of pipe welding fittings. Midwest piping research is continuous.

"Can he be of any special help on my job?"

MIDWEST gives you the benefit of a thoroughly experienced organization prepared to offer the advantages of any new piping developments. Our wide experience in all kinds of pipe work often enables us to make suggestions which result in better piping at lower cost.

MIDWEST PIPING & SUPPLY CO., INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

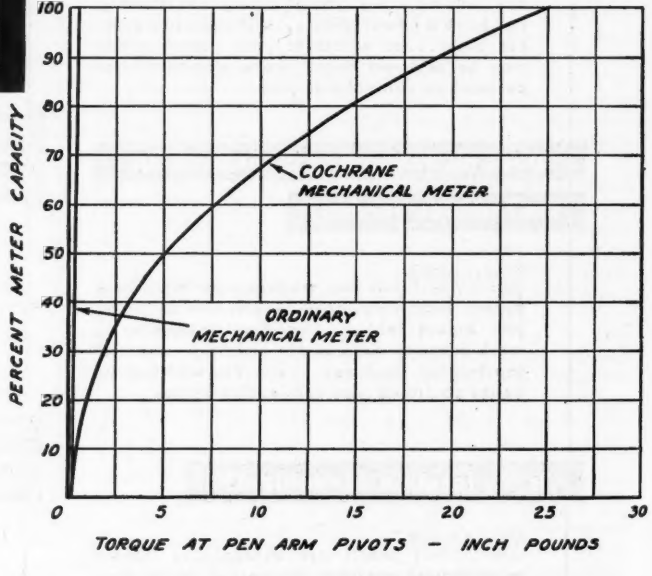
Plants: St. Louis, Passaic (N. J.) and Los Angeles • Subsidiary: Lumsden & Van Stone Co., South Boston 27, Mass. • Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St.

PIPING FABRICATORS AND CONTRACTORS

ACCURACY = POWER / friction *

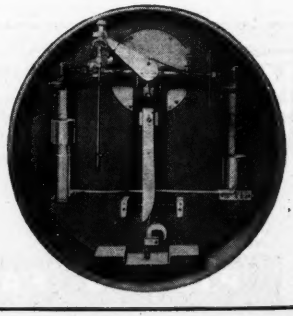
The Most Powerful Flow Meter Ever Made

That is an unusual statement to make about any commercial product, but the evidence, as shown by the test chart at the right, leaves no room for doubt. • At high scale, the Cochrane Tilting U-tube Meter develops a torque of 56 inch-pounds (8 lbs. of mercury operating on a 7-in. radius). Other mechanical type meters develop only a few ounces of torque.



THE SECRET OF COCHRANE POWER

The difference in rate of flow in the pipe line changes the level of the mercury in a sealed U-tube which is balanced on a knife-edge bearing. As the mercury shifts from one side to the other of the U-tube, the balance swings, moving indicator, pen arm and integrator to record the change in flow. Simple... powerful... never-failing. If you have a tough metering job, if your operators are unskilled in instrument care and maintenance, if you want the simplest and most powerful flow meter made, this Cochrane Tilting U-tube Meter was made for you. Write today to Cochrane Corporation, 3123 N. 17th St., Philadelphia 32, Pa.



Power as expressed in the formula at the top of this page, in ratio to low friction, is the secret of flow meter ACCURACY

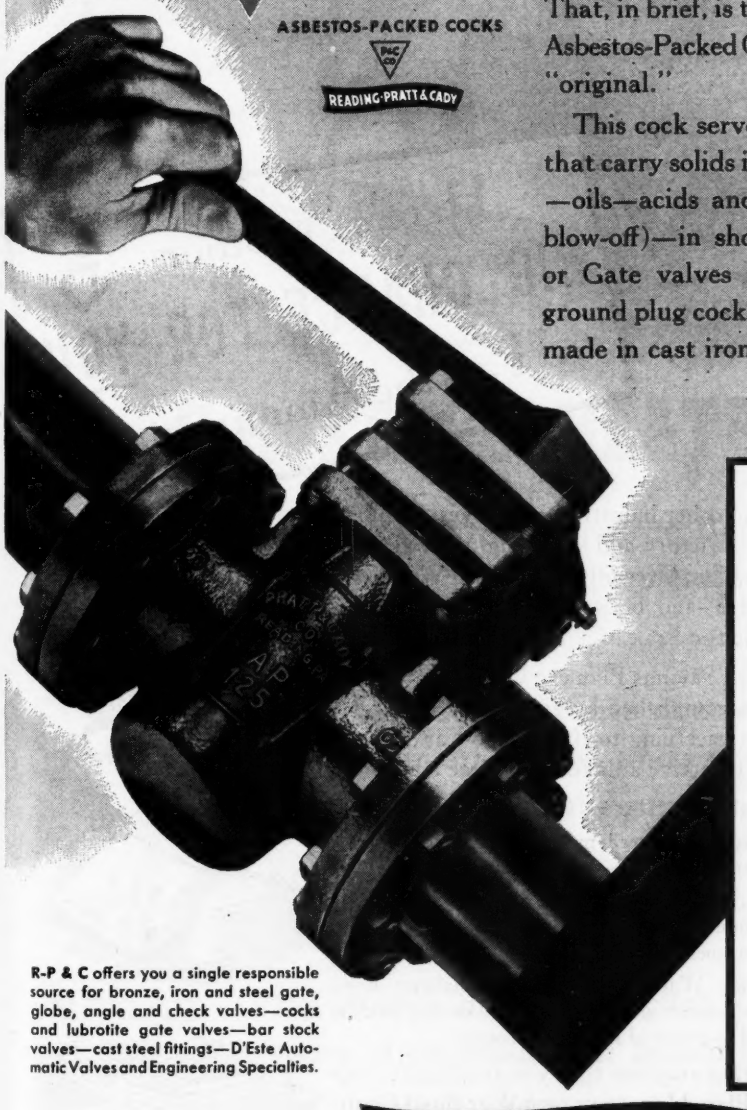
Designed TO WORK MORE EASILY—
Built TO LAST LONGER—

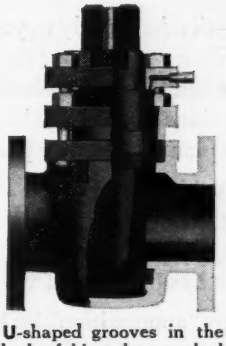
That, in brief, is the story of this double gland Asbestos-Packed Cock—a **READING-PRATT & CADY** "original."

This cock serves best as a shut-off on lines that carry solids in suspension—viscous fluids—oils—acids and alkalis—steam (for boiler blow-off)—in short, wherever Globe, Angle or Gate valves fail or where conventional ground plug cocks prove unsatisfactory. It is made in cast iron, bronze and cast steel.

ASBESTOS-PACKED COCKS

READING-PRATT & CADY





U-shaped grooves in the body of this cock are packed solidly with asbestos, which is then vulcanized. This provides a bearing which absorbs expansion and eases operation. The double gland feature—independently controlled pressure on plug and top packing—still further eases operation and prolongs life.

R-P & C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Valves and Engineering Specialties.

READING-PRATT & CADY

MANUFACTURERS OF

READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa. • Atlanta • Boston • Chicago • Denver • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

ACCO

TRADE MARK

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

In Business for Your Safety

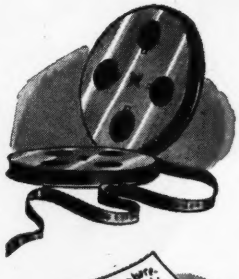
TO COMPANY PRESIDENTS:

Here's Another BIG CHANCE FOR YOU to "Pass the Ammunition!"

Today—thanks largely to you and other industrial executives—22,000,000 civilian workers are speeding victory and achieving postwar security through the Payroll Savings Plan. Over 60% of the 6th War Loan subscriptions came from this source—and, between drives, this forward-looking plan has been responsible for 3 out of 4 War Bond sales!

Good as this record is, the Payroll Savings Plan can be still more effective. Believing this can best be accomplished by giving Bond buyers a definite idea of the many benefits accruing to them, the War Finance Division has prepared a variety of active aids for employee education.

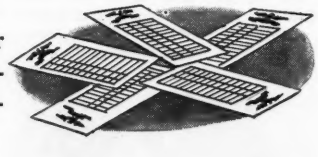
This new "ammunition" includes:



a—An entertaining, swift-paced moving picture, graphically showing the importance of buying—and holding—War Bonds.

b—An interesting, easy-to-read booklet, explaining how War Bonds may be accumulated to provide education for children, homes, retirement incomes, etc.

c—Attractive, handy War Bond envelopes, enabling Bond holders to note each separate purchase—and the specific purpose for which each Bond or group of Bonds was bought.

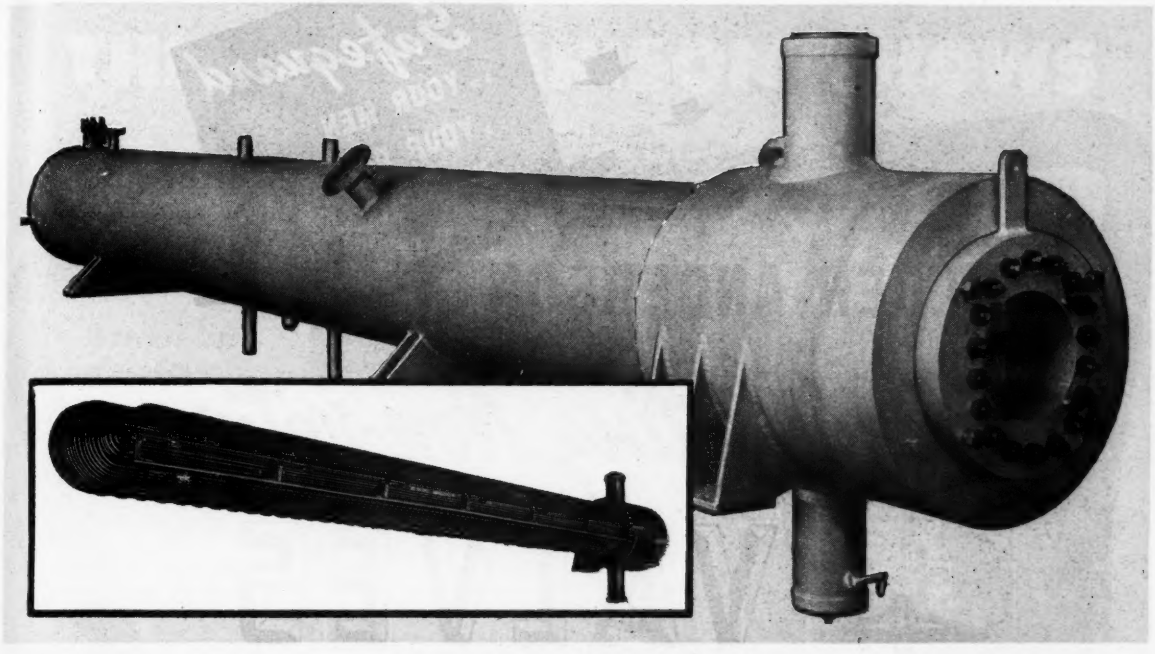


Passing this particular ammunition requires that you reappraise your own company's Payroll Savings Plan. Have your own War Bond Chairman contact the local War Finance Committee—today! They will welcome the chance to discuss this new program with you.

The Treasury Department acknowledges with appreciation the publication of this message by

Power Plant Engineering

★ *This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council* ★



This G-R STAGE HEATER combines

SIMPLICITY... because the U-tube construction and tube sheet integral with water head requires a minimum of high pressure joints.

RUGGEDNESS... because of sturdy construction; including ample support of tubes, and prevention of vibration by minimum clearance at tube support plates.

ACCESSIBILITY... because the only high-pressure joint is a single manhole cover.

The design and construction of this unit is based on 76 years of experience in building heat transfer apparatus.

Write for Bulletin

The Griscom-Russell Co.
285 Madison Avenue
New York 17, N. Y.

GRISCOM-RUSSELL

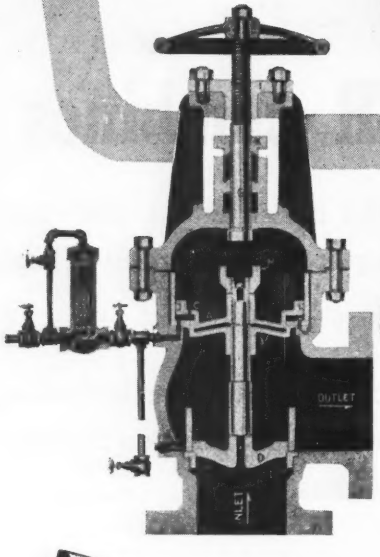
Pioneers in Heat Transfer Apparatus

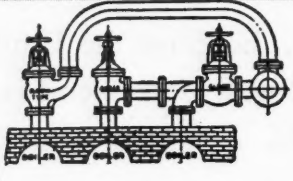
Safeguard
.. YOUR MEN
.. YOUR PROPERTY
.. PRODUCTION
WITH

GOLDEN-ANDERSON

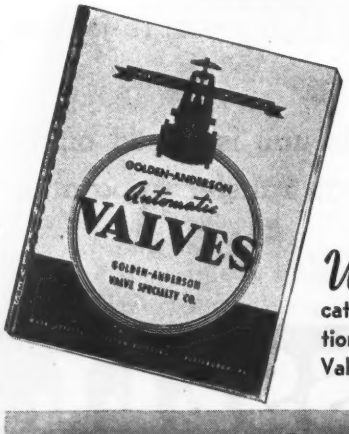
Triple-acting, Non-return

VALVES





You can make safety in your boiler plant a certainty when you use GAVSCO Triple-acting Non-return Valves. In the event of a blown tube or a pressure line break, this valve will immediately cut off the flow of steam, isolating the boiler and preventing any possible damage to your workers, property or production. . . . Comes with either flanged ends or welded necks, and handles 150 lbs. to 1500 lbs. May be tested for automatic operation while under pressure. It's the heaviest valve of this kind made. In angle, globe, or elbow types from 2½ in. to 12 in. in size. Valve shown is standard yoke design.



Write today for your copy of our latest catalog. Contains complete construction and application data on this and all other GAVSCO Specialty Valves; also has a lot of helpful engineering data.

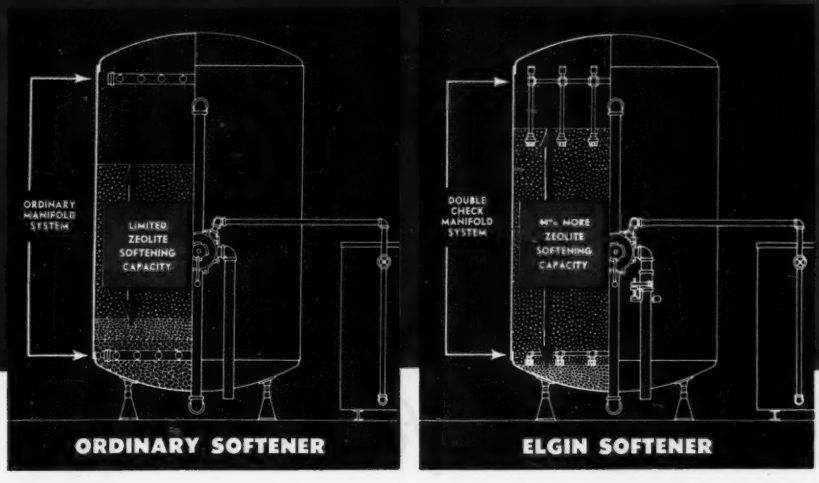
GOLDEN ANDERSON VALVE SPECIALTY CO.

FULTON BUILDING • PITTSBURGH, PA.

THIS COMPARISON SHOWS

how Elgin Water Softener gives

44% MORE SOFT WATER



Ingenious "Double-Check" manifold system does it!

THERE is nothing mysterious about the 44% increased soft water output of the new Elgin Zeolite Water Softener. The whole story is told by the two drawings above—at the left, the conventional softener; at the right, the new Elgin.

Tank sizes are the same, but note the far larger zeolite content of the Elgin Softener. Note, also, the totally different Manifold used in the Elgin. This exclusive "Double-Check" design makes the deeper bed possible without loss of zeolite—a loss that the conventional softener attempts to avoid by using a shallow zeolite bed as diagrammed above.

Of course more zeolite means more soft water output, for it's the zeolite that does the job. But the ingenious "Double-Check" Manifold system goes beyond that . . . permits zeolite to be washed cleaner . . prevents packing and channeling of the bed. Thus the brine reaches every portion of the zeolite, producing more efficient regeneration with less salt consumption.

Increase the soft water output of your present water softener with the "DOUBLE CHECK" MANIFOLD SYSTEM

The "Double-Check" Manifold System is adaptable to water softeners of any make. This change, supplemented by remarkable ELGIN HIGH-CAPACITY ZEOLITE will greatly increase soft water output and operating efficiency. The cost of such modernization is surprisingly low

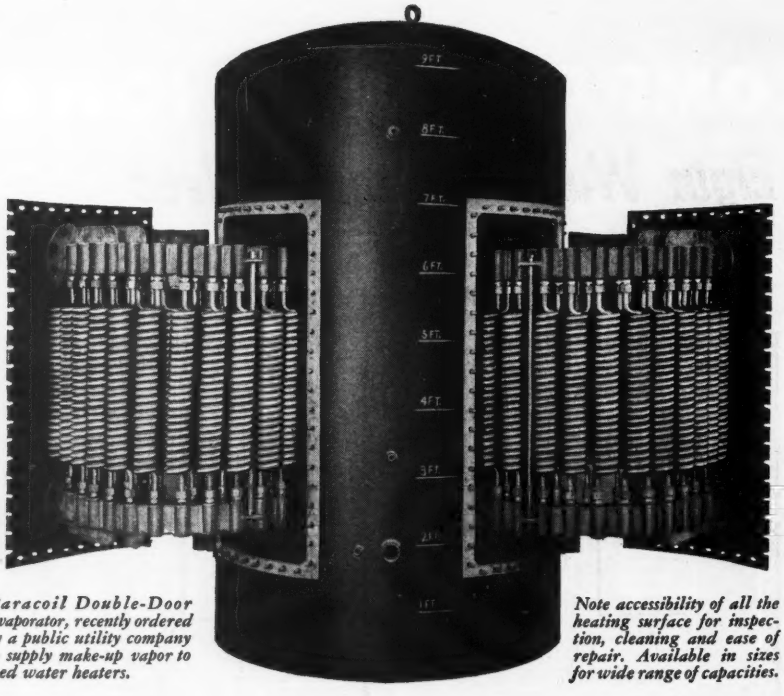
In these high pressure times, most plants have too little soft water. Here is the answer to your need for more soft water, not only for boilers, but for hot water systems, processing, or any other need that may exist.

For facts about the Elgin Softener or modernization of your present water softener, write for Bulletin 603.

ELGIN SOFTENER CORPORATION, 136 N. Grove Ave., Elgin, Ill.

ELGIN
ECONOMICAL WATER CONDITIONING

WATER CONDITIONING FOR EVERY NEED



Paracoil Double-Door Evaporator, recently ordered by a public utility company to supply make-up vapor to feed water heaters.

Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in sizes for wide range of capacities.

Plan Now...for Maximum POSTWAR EFFICIENCY

TO eliminate any possibility of delay that other peacetime replacement demands may create, far-sighted plant officials have already started to check Heat Exchange equipment to determine that which may be obsolescent, depreciated beyond repair or insufficient in capacity for present or future loads. Equipment which has proved uneconomical or unsuited to present or contemplated operating conditions, and that which requires continuous costly servicing likewise indicates the necessity of carefully planned replacement.

Orders for the units listed in column at right can now be filled on reasonable delivery schedules, if accompanied by suitable priorities. Davis engineers will help you to prepare for maximum peacetime efficiency in selection of Heat Exchange Equipment. We will be pleased to submit recommendations or proposals on your particular heat transfer problems or requirements.

Paracoil

These Paracoil products will fill many of your replacement or new equipment needs.

EVAPORATORS
For boiler water make-up.

DISTILLATION PLANTS
To supply distilled water for process.

FUEL OIL HEATERS
For service-free operation.

CLOSED FEED WATER HEATERS
For higher temperatures.

WASTE HEAT BOILERS
For heat recovery from diesel engine exhaust.

BLOW DOWN HEAT EXCHANGERS
For recovery of heat from boiler blow down.

CONDENSATION COOLERS AND PREHEATERS
For recovery of heat from waste liquids.

CONDENSERS
For recovery of vapors.

WATER HEATERS AND MISCELLANEOUS HEAT EXCHANGERS
For process heating or cooling.

SINCE 1915
Paracoil
HEAT TRANSFER EQUIPMENT

DAVIS ENGINEERING CORPORATION
1068 EAST GRAND STREET, ELIZABETH 4, NEW JERSEY

Maintenance made easy with POWELL VALVES

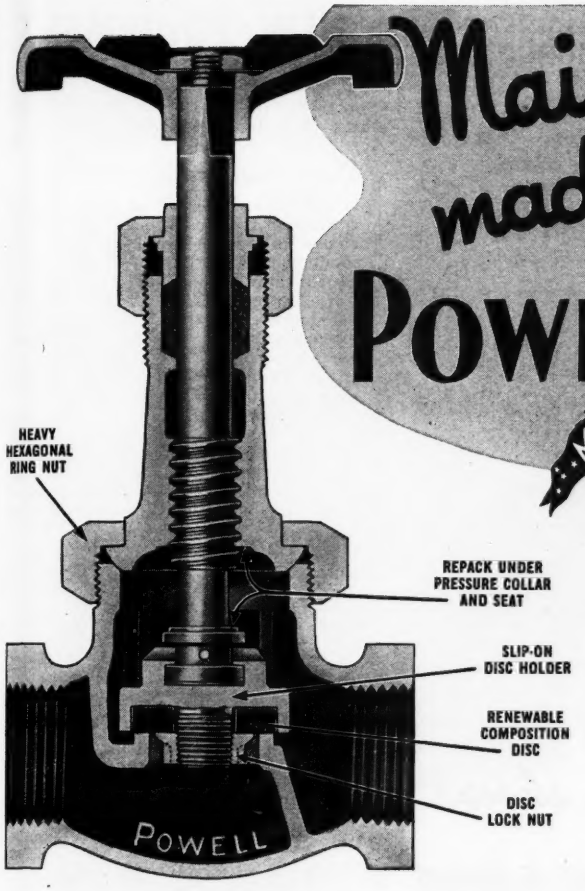


Fig. 150
BRONZE "UNION" COMPOSITION DISC GLOBE VALVE

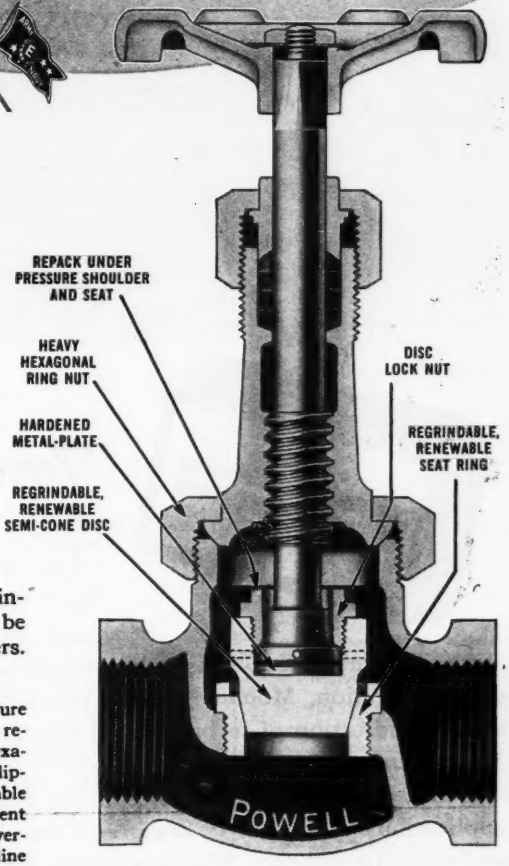


Fig. 1708
BRONZE "WHITE STAR" GLOBE VALVE

In these days of round-the-clock operation, time spent in the maintenance of equipment means a loss in production that can never be made up. If it's flow control equipment, Powell has the answers. Here are two examples.

Fig. 150—a Union Disc Globe Valve—is an economical valve for low pressure steam, oil, water, gas or air. The composition disc can be quickly and easily replaced without removing the valve from the line merely by backing off the hexagonal ring nut, lifting the bonnet assembly out of the body and removing the slip-on disc holder. The discs, especially for the smaller sizes, are readily obtainable and very inexpensive. Discs of various compositions are available to meet different service conditions and the importance of using the *right* disc cannot be overemphasized. The seat can be refaced without removing the valve from the line as indicated above.

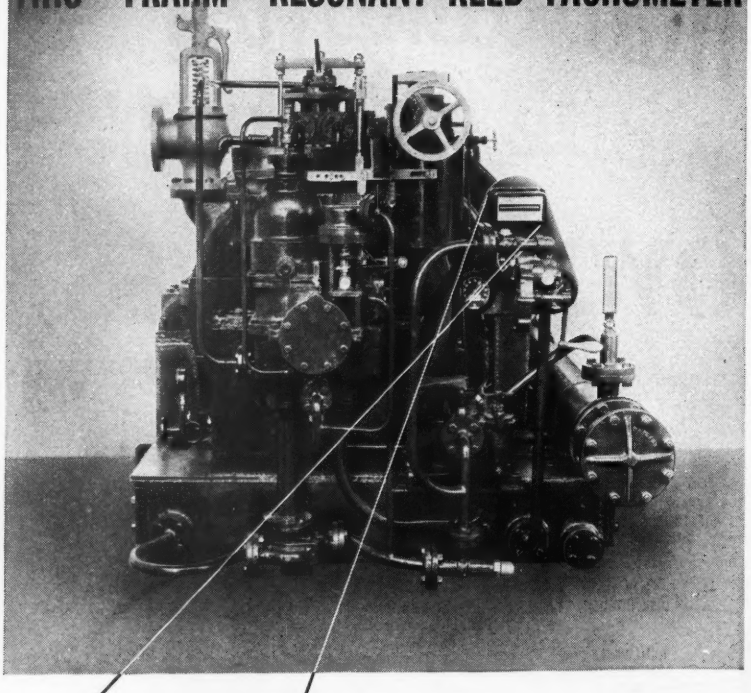
For *extra long life*, Fig. 1708 is recommended. The seat ring and disc are made from special hard metal compositions. The hardness of the seat and disc, with their wide contact surface, tends to resist erosion and corrosion over a long period of time. Without removing the valve from the line, seats and discs can be reground to a new tight bearing and, when necessary, new ones can be easily installed. No special tools are required.

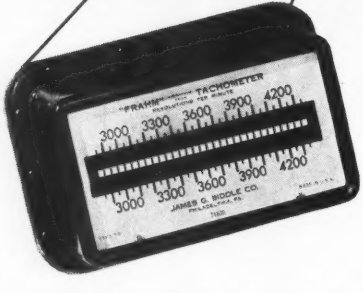
All Powell Valves that require repacking are provided with a specially machined cut-off to permit repacking under pressure when wide open.

The Wm. Powell Co.
Dependable Valves Since 1846
Cincinnati 22, Ohio

POWELL VALVES

THIS "FRAHM" RESONANT REED TACHOMETER





. . . shows Turbine speed

This is the turbine end of a 300 kw turbine-generator unit built by the Moore Steam Turbine Division of the Worthington Pump and Machinery Corporation. Mounted on the panel board to give a continuous indication of turbine speed is a Frahm Resonant Reed Tachometer.

Frahm Tachometers are chosen for this and many similar applications because of their extreme simplicity of construction and unfailing accuracy. Having no belts, shafts, gears, springs or delicate parts there is nothing to wear out, and they can be depended upon to function faithfully without attention—year after year after year.

Frahm Tachometers are supplied in both stationary and portable types, with various ranges available from 900 up to 60,000 r.p.m.

Write for Bulletins 1590-PE and 1740-PE. They give a complete description of the instruments and list all types and ranges commonly supplied.

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

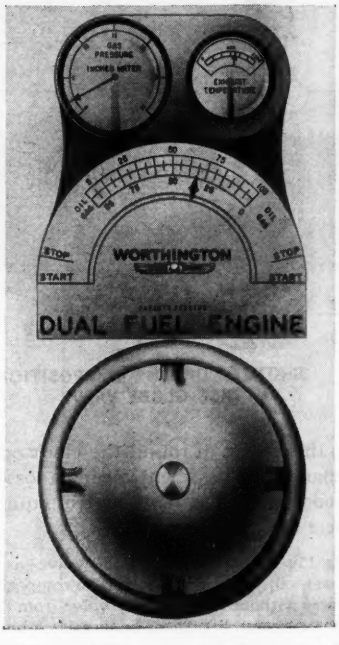
NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

Dual Fuel Engine

AN ENGINE capable of instantaneous conversion from oil to gas fuel without change in load or speed has gone into production at the Buffalo Works of the Worthington Pump and Machinery Corp., Harrison, N. J. Conversion from one fuel to the other or adjustment of a combination of both is accomplished by one revolution of a single control wheel. The first installation is operating in a large municipal plant.

The Worthington dual fuel engine is able to burn either gas or oil or both together. Regardless of the fuel being used, the engine operates on the highly efficient Diesel cycle, thus realizing fuel economies heretofore unobtainable in gas engine operation.



The unit does not require a high pressure fuel gas supply to the engine, only two inches of water pressure is used. When operating a gas engine, pilot oil ignition is used, eliminating electric ignition. Pilot fuel can be used in amounts as low as 5 per cent of the total full load Btu requirements of the engine.

Although the flexibility of this new system makes it applicable to many fields, it is most ideally suited for use in sewage plants, oil fields, industrial and municipal plants, gas utilities and refinery services.

Oil Sludge Control

SLUDGE DEPOSITS in fuel oil systems are recognized as deserving more attention than they are ordinarily given. They may form in tanks or in parts of the piping system and whenever they exist they are a constant menace to proper operation of the firing system for they clog screens and burner orifices to such

They don't come much more special

★ You won't find a welding fitting like this listed in anybody's catalog. In addition to having integrally formed side outlets, probably never before provided in a welding elbow, these are "special" all the way — special steel, special size and special wall thickness.

Naturally we aren't out looking for unusual problems now. In normal times however we like to tussle with these tough assignments and even today we are glad to tackle them when the war effort requires.

★ Every one of the hundreds of problems like this that we have tackled and solved across the years has added its important bit to our knowledge of controlling hot metal under pressure and impact. And this accumulated "know-how" has found its best expression in our standard line of WeldELLS and other Taylor Forge Welding Fittings.

That is why you find features in WeldELLS that are not combined in any other welding fittings . . . tangents . . . extra metal distributed where strains are greatest . . . extremely accurate dimensions . . . just to mention a few that call for special processes and complete knowledge of forging technique. Check the list of features opposite and you will agree that in everything conducive to sound engineering and utmost economy in pipe welding—

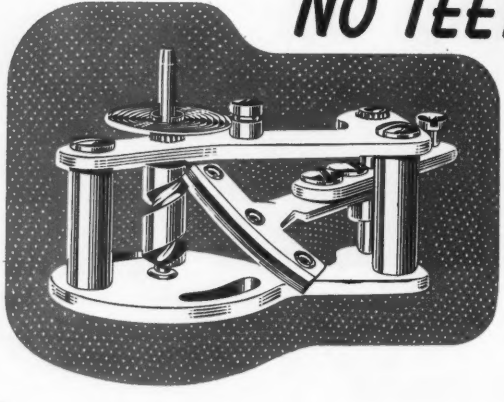
WeldELLS alone combine there features:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** —simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

"LOOK MOM, NO TEETH!"



This is no joke. To Mom it is serious. And to you also "no teeth" is an important matter, if you use pressure gauges. Now you can get Certified Gauges with the new, patented Helicoid Movement and that means no teeth to wear out.

After serving in the Navy for several years, Certified Gauges are now available to industry for prompt delivery.

If you've had gauge trouble due to movements wearing out or getting sticky, investigate Certified. Try one on some really tough service. See for yourself how much longer they wear and remain accurate. Ask the man who uses them.

Only Certified Gauges are made with the Helicoid Movement. All Certified Gauges are guaranteed accurate to within ½ of 1%. Send for catalog today.

Certified GAUGE
AND INSTRUMENT CORP.

34-18 Northern Boulevard — Long Island City 1, New York

an extent as frequently to force shutting down burners. Continuity of service and efficiency of combustion demand uniformity in the consistency of fuel oil and this is impossible when sludge accumulation exists in the oil.

Chemical agents have been developed by the Magnus Chemical Company, Garwood, N. J., for the elimination or control of these sludge troubles. They act as oil soluble dispersing agents on the sludge and water which are the basis of these difficulties. This type of agent disperses the sludge evenly throughout the entire body of the oil and it is thus burned with the oil as it is used. The treatment lowers the surface tension of the oil, also the viscosity, making it flow easier and atomize better with resultant more prefect combustion.

The chemical employed is a brown, oily liquid, which is non-volatile, though readily and completely combustible, burning along with the oil to give the same products of combustion—carbon dioxide, nitrogen and water vapor. The amount used for inhibiting sludge formation in Bunker C oil is 1 pt per 1000 gal of oil. Where sludge exists in a tank, 1 pt is added to each 400 gal of combined oil and sludge. This chemical does not affect the flash point of the oil, nor does it have a harmful effect on the metals or parts of the oil burning system.

Metallic Arc Welding Process

LINCOLNWELD, a new type of automatic welding has just been announced by The Lincoln Electric Co., Cleveland, Ohio. This development has established its practicability over a period of several years during which many units have been highly successful in welding a variety of products.

The process is designed for use with direct current, utilizing a bare metallic electrode which is fed through a granular flux deposited on the joint to be welded. Sufficient flux is applied to completely blanket the arc and the molten metal; the unfused flux is then reclaimed for further use.

Direct current offers simple and positive control; ability to weld non-ferrous materials; and control of electrode melting rate through the option of either straight or reverse polarity.

Extremely high current densities are used. For example, ⅛-in. diameter elec-

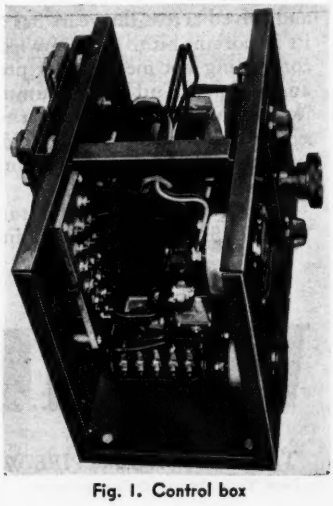
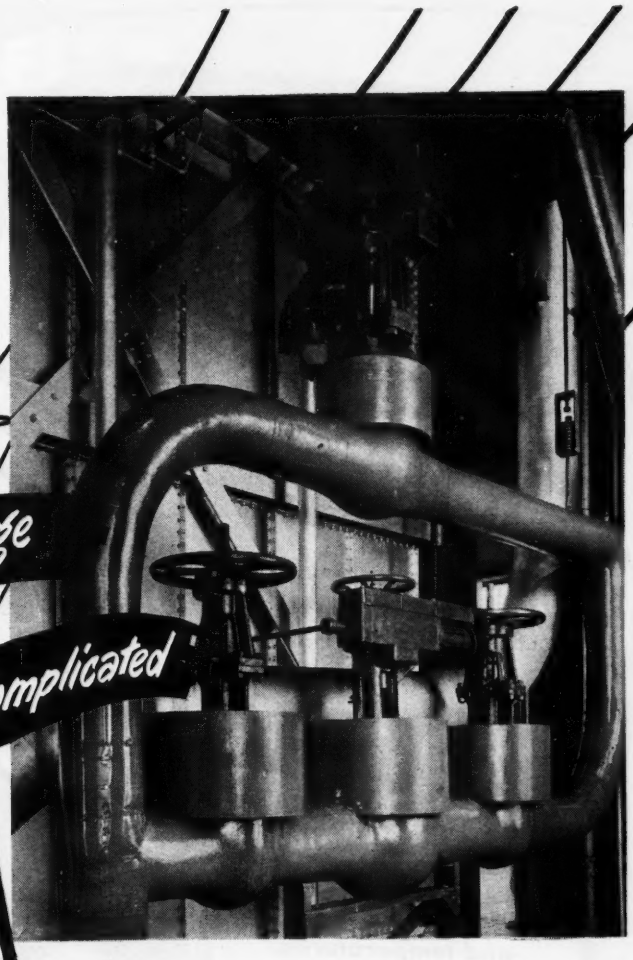


Fig. 1. Control box

CALL NAVCO
on
POWER PIPING PROBLEMS



Small or Large

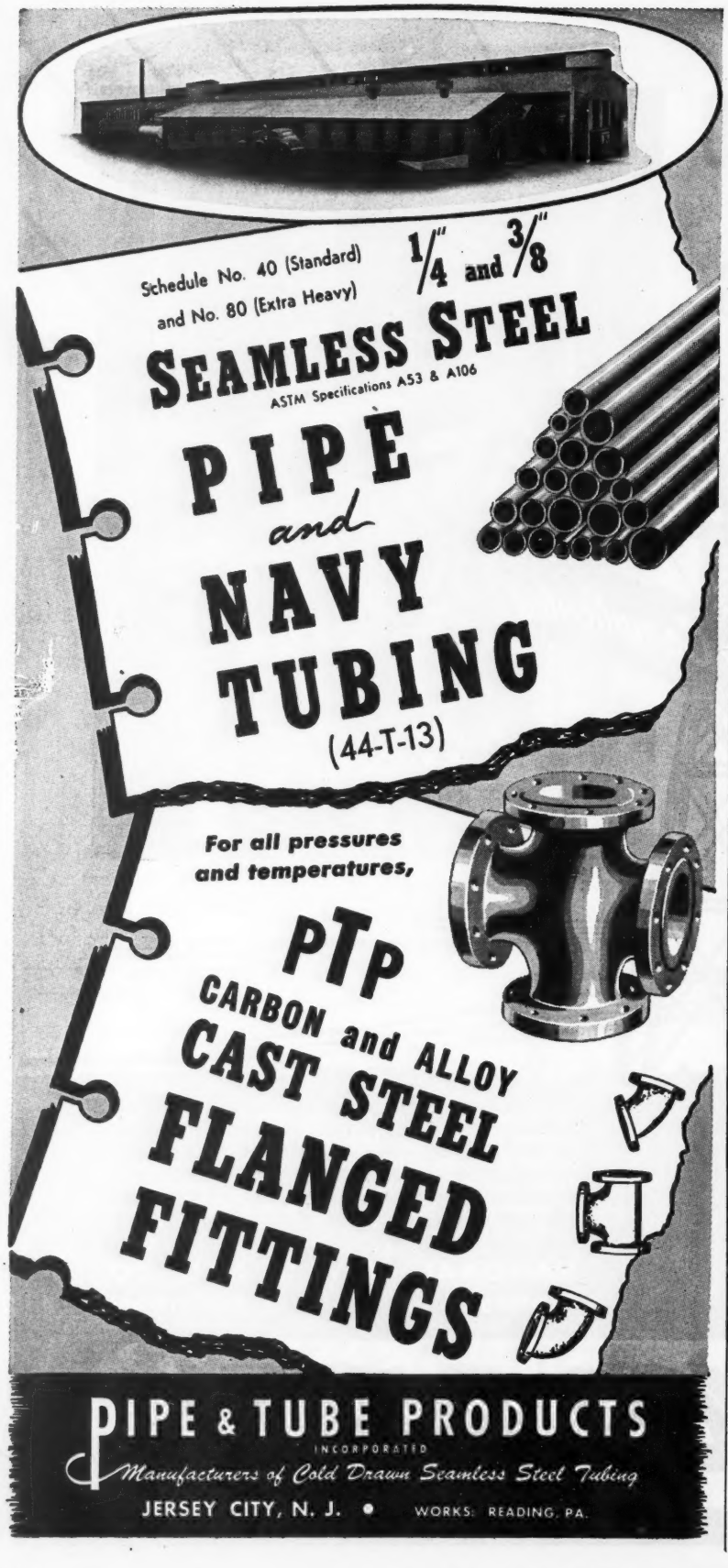
Simple or Complicated

Whatever your Piping problem may be, Navco is in position to help you. The knowledge which we have gained in the past 36 years has not been confined to design and fabrication alone. It includes a wide field of experience in erecting and testing Piping Systems for every Service.

NATIONAL VALVE & MFG. CO.
Pittsburgh 1 Pennsylvania

NAVCO

NAVCO PIPING



trode may carry as much as 650 amp. This produces greater penetration and permits smaller cross-section of weld metal with resulting saving in cost and reduced warpage and distortion.

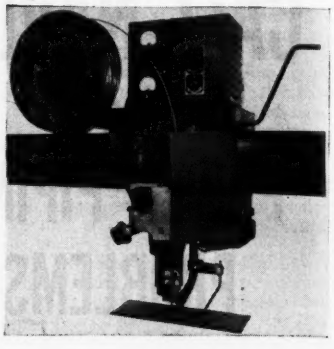


Fig. 2. Carriage type mounted on overhead beam

Lincolnweld process is reported to be less sensitive to scale and moisture than conventional automatic welding methods. This eliminates or reduces plate cleaning prior to welding. In extreme cases of scale, buffing with power wire wheel usually provides sufficient edge cleaning; whereas grinding and sand-blasting might have been required formerly.

The particular advantages reported for Lincolnweld over existing processes are as follows:

First—One type and grade of flux, together with one analysis of electrode, can be used with the same procedure for a wide range of steel analyses.

Second — The equipment will take ⅛-in. to 7/32-in. electrode without changes of drive rolls, wire contacts or control. The control is extremely simple and quick acting. The electrode will feed in either direction by means of the wire motor being controlled through a special exciter. Figure 1 shows an inside view of the automatic control box with current, arc voltage, and travel speed rheostats in one compartment; while the other contains the ammeter, voltmeter and two contractors for the operation of the equipment. This gives the operator quick and easy control over voltage, current and speed when changing from one job to another.

The welding head is normally used in conjunction with a specially built automatic welding set of 1200 amp capacity.

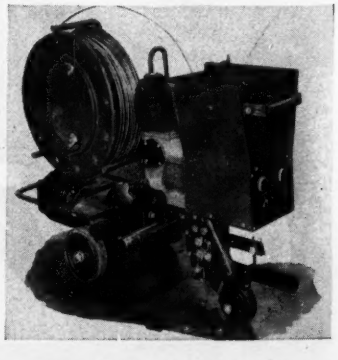
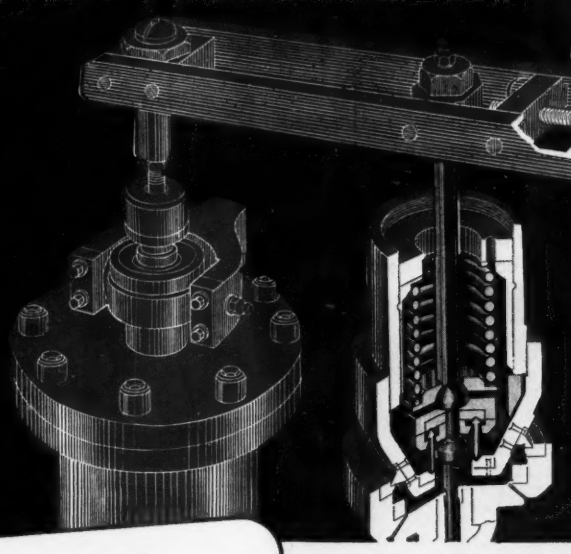


Fig. 3. Motor driven tractor type

SIMPLIFIED SPEED CONTROL



A feature of
HENDY
TURBO-GENERATORS

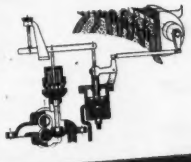
HENDY'S simplified governor system will pay you dividends

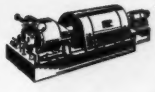
This governing system is positive in action—and extremely sensitive from no load to overload. It is a simplified and compact unit of the oil-relay and centrifugal type. An overspeed trip mechanism within the governor assembly automatically closes the throttle at 110% normal speed. Additional safety is provided by the hand-operated emergency trip button which, because of its location and method of operation, effectively prevents accidental tripping and purposeless shutdown.

Another new design feature of this governor system makes synchronization easy; through the use of a vernier-type screw, turbine speed-load characteristics can be accurately adjusted within a range of 5% above or below normal.

This simplified governor system is only one of many advanced Hendy features that pay you dividends in lower maintenance costs and efficient operation. Details of other dividend-paying features will follow in succeeding advertisements.

Hendy turbo-generators are available in sizes from 250 to 750 kw. When requesting detailed information, please indicate electrical requirements, steam conditions, and type of service involved. Phone or write your nearest Hendy office.





Because this new Hendy Turbo-generator is *simplified,* it is dependable and efficient. Not only have general characteristics been bettered, but individual parts have also been improved—made *simpler* and more dependable through ingenious design.

This is true of the set throughout. Turbine, reduction gear, and generator—all were designed and built as *matched* units. And *all* are built by Hendy, giving you complete power equipment from *one* responsible source.

Here are just a few of the features of this set: an extremely accurate governor mechanism that reduces maintenance because it has no packing or stuffing boxes . . . easy accessibility to all parts subject to wear or replacement . . . neat, trim contours and reduced external piping, made possible by the placement of filters, strainers, and controls in protected locations. These, and the many other features of this turbo-generator, combine to make a smooth-running, dependable power plant for a wide variety of industrial applications.

JOSHUA HENDY IRON WORKS
ESTABLISHED 1856
SUNNYVALE, CALIFORNIA

62-TB-7

Branch Offices: **BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • ST. LOUIS • WASHINGTON**

DEPENDABILITY WITH PLUS WIZARD PRESSURE PILOTS

FOR PUMP GOVERNOR SERVICE
PRESSURE RELIEF SERVICE
PRESSURE REDUCING SERVICE

Simple in design yet dependable and accurate — controlled pressures maintained within 1% plus or minus. Integral mounting provides compact one unit controller—no pipe connections from pilot—minimum of time lag. Direct or reverse acting pilots available for all sizes of control valves. Write for complete details.

FEATURING

1. Thumb screw adjustment of throttling range — 1% to 75% of tube range.
2. Vernier screw adjustment for setting controlled pressure.
3. Highly sensitive Bourdon tube of bronze or steel for various pressures.
4. Pilot assembly an integral part of diaphragm casing.
5. Weather proof mounting for gauges — indicate operating medium pressure and pressure on the diaphragm.
6. Auxiliary operating medium regulator standard equipment.
7. Controlled pressure connection with auxiliary tapping for gauge mounting.

FISHER GOVERNOR COMPANY
1025 Fisher Bldg., Marshalltown, Iowa

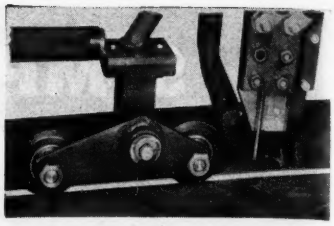


Fig. 4. Roller guide for butt joint of work

The current rheostat in the automatic control box permits a current range of 300 to 1200 amp. The unit has two exciters, one for the automatic head control and one for the welder field excitation. The welder control box has provisions for easy and quick wiring of the automatic.

Figure 2 shows the welding head, with flux hopper, wire reel and control mounted on a motor driven carriage. Figure 3 shows head mounted on the portable tractor unit. This has straight wire guide for butt welding. For square butt welding, a pointer is used for following irregular seams. For prepared joints, roller guides are provided for engaging the seam, (see Fig. 4).

The standard head is changed from butt to fillet welding in a matter of only a few minutes. In making fillet welds the lower wire guide and flux tube are changed from straight to curved, thus permitting the head and wire reel to be left in its normal position. The wire is fed in at 40 deg from horizontal which gives the maximum effective throat for horizontal fillet welds.

New Gas Engine Design

A NEW DISCOVERY in the Diesel engine field, which will enable the engine operator to use either gas or oil as fuel without any electrical sparking device, has been revealed by Ralph L. Boyer, chief engineer, of The Cooper-Bessemer Corp., Mount Vernon, Ohio.

The new discovery is the result of experimentation which began in 1928. Recently efforts have been rewarded by the successful operation of a natural gas engine on the Diesel principle. This enables the unit to operate on a wide variety of fuels including fuel oil, natural gas, manufactured and coke oven gases, sewage gas, and refinery by-products.

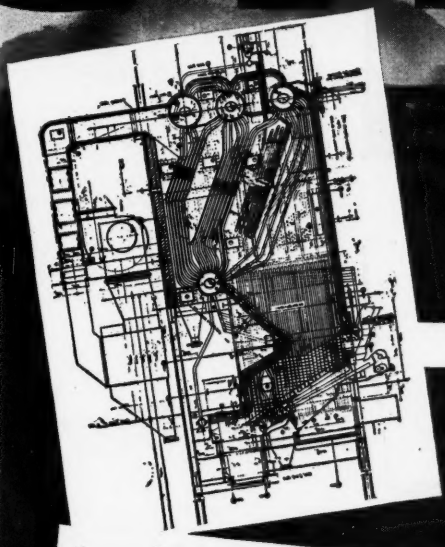
The conversion from liquid to gas fuel is as simple as the closing of one valve and the opening of another with the engine operating continuously at full load. Although conversion from one fuel to another has been possible in the past, it has always been necessary to shut down and exchange major or minor parts of the engine.

The new principle will enable the engine to have the same fuel economy regardless of the type of fuel used. It raises the normal 25 per cent thermo-efficiency of the gas engine to the 35 per cent thermo-efficiency common in Diesel oil engines, according to Mr. Boyer.

The new Cooper-Bessemer development makes possible the use of gas at normal pressure and the change from one fuel to another without the necessity of a shut-down.

The Cooper-Bessemer Corp. has engines embodying the new principle in production along with their standard line of marine and stationary engines and standard compressor units.

STEAM *for*

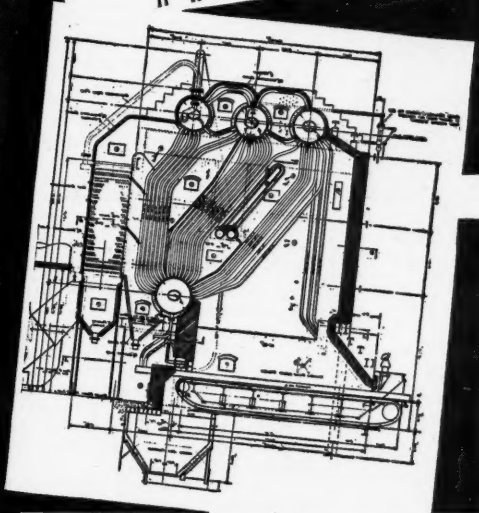


POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.

•

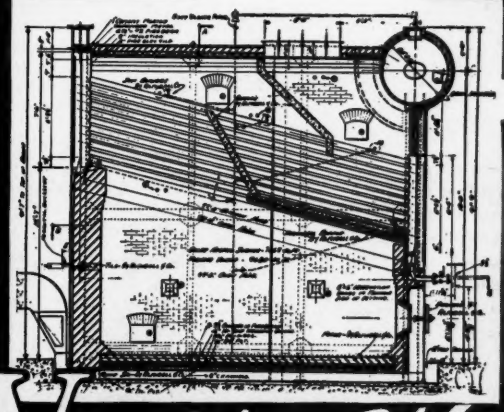


PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.

•



HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND CHICAGO PHILADELPHIA DALLAS

Vogt *Water Tube* BOILERS

BENT TUBE AND SECTIONAL HEADER TYPES

DARTS

Fit Without Freezing

2 Bronze Seats Ground to a True Ball Joint

No Straining to Uncouple

Can Be Used Over and Over Again

Because its two bronze seats are ground to a true ball joint, the Dart Union makes a drop-tight connection without heavy wrenching. It uncouples as easily . . . can be used over and over again wherever needed. Made of high-test, air-refined malleable iron, it is practically unbreakable. Ask your supplier to send Dart . . . the *real* economy union.

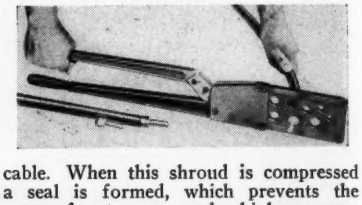
DART UNIONS LIVE LONGER

E. M. DART MANUFACTURING CO., PROVIDENCE, R. I.

In addition to the convertibility feature and the possible fuel saving, the new discovery in Diesel operation will mean the elimination of one of the greatest fire and explosion hazards in the gasoline refining industry because there will be no necessity for using any ignition or sparking device.

Tool for Installing Electrical Connectors

BURNDY ENGINEERING Co., 107 Bruckner Blvd., New York 54, N. Y., has recently placed on the market a new tool which simplifies the installation of Hyseal Thimbles such as are commonly used on Navy, insulated, electrical cables. The Burndy Hyseal Thimble, for which this tool is used, is the integral combination of the Navy thimble and a shroud for sealing the end of the



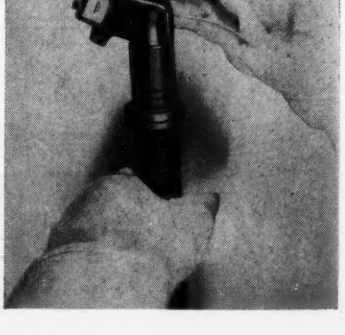
cable. When this shroud is compressed a seal is formed, which prevents the entry of water even under high pressure.

This new Hytool eliminates the necessity of a separate pair of dies for each thimble size such as is required in hydraulic presses. The "spade" of the new tool carries a series of holes or "dies" which provide for the installation of a number of thimble sizes, so that no parts have to be changed. One stroke of the handle completes the watertight sealing operation.

Electrode Holder

A NEW electrode holder, designed to allow unobstructed visibility while welding and maximum accessibility even for deep pocket work, fast loading and reloading, plus the war-necessary feature of more completely using up the electrode, has just been announced by the Hollup Corp., a division of the National Cylinder Gas Co., 205 W. Wacker Drive, Chicago 6, Ill.

This new "Shortstub" electrode holder is designed to increase the usable portion of the electrode to a point right up to the uncoated end of the rod. With the "Shortstub" holder, only one-half inch is needed for a tight, efficient current contact in the holder jaw. An extension of the holder itself allows the now usable



DETRICK SUSPENDED CONSTRUCTION

ABOVE THE FURNACE

Many operators of large boilers have had difficulty in maintaining full capacity because of infiltration through the upper firebrick walls. The very nature of firebrick causes it to move, especially when there are large areas with varying temperatures.

There are other operators who put in Detrick Suspended Walls behind the tubes and in the upper furnace area. They have found that they can get maximum performance and maintain peak loads without difficulty.

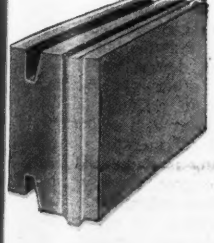
The airtightness of these Detrick Suspended Walls is due to the suspended construction, the intermeshed shape of the tile, the insulation held directly against the back of the tile, and the casing cement which is applied on the outside with a trowel.

The suspended construction by which each tile is held in position and each section is supported independently of the one above and below confines temperature movements to small areas and thereby avoids strains and cracks.

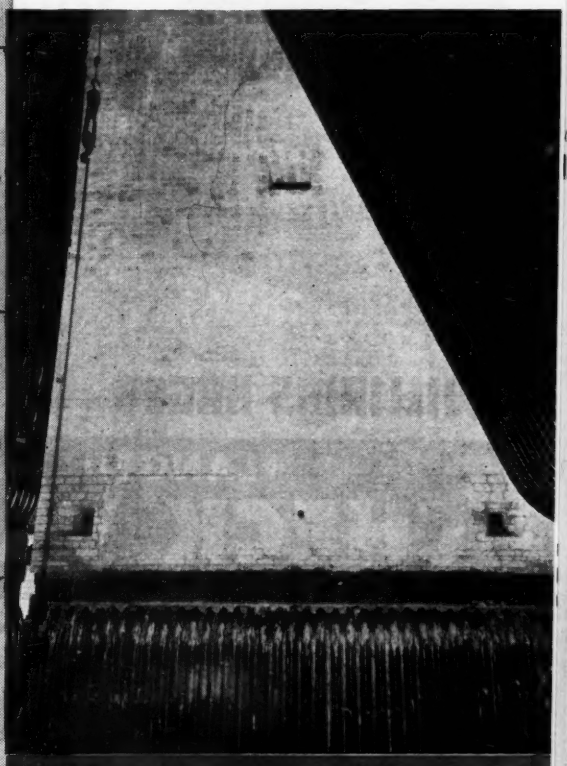
The entire wall is engineered to provide a heat-tight enclosure which prevents air infiltration and reduces heat loss to a minimum.

For improvement in present construction or for post-war plans, consult Detrick engineers on your furnace enclosure problems. Send us your blueprints for suggestions and ask for the new booklet "Detrick Furnace Enclosures" which will bring you up to date on this important subject.

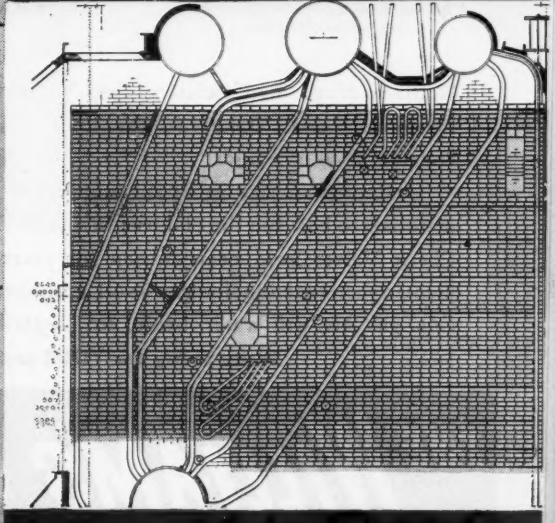
M. H. DETRICK COMPANY
111 West Washington Street Chicago 2, Ill.



The Thinsulite Tile provides a thin refractory face which is backed up by insulation and a plastic casing.



Detrick construction in the upper furnace area and behind the



If it's a problem of enclosing heat . . . a job for Detrick

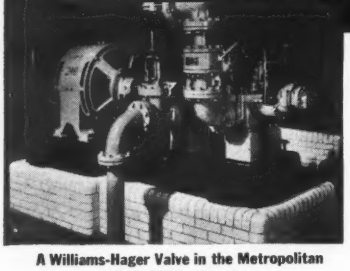
DETRICK FURNACE ENCLOSURES

DETRICK INSULATION PLASTIC or BLOCK

THIS NEW INFORMATIVE CATALOG WILL SOLVE YOUR "WATER HAMMER" Problem!

WILLIAMS-HAGER

FLANGED Silent
CHECK VALVES



A Williams-Hager Valve in the Metropolitan Life Building, New York.

- Precision Engineered
- Economical
- Efficient
- Frictionless
- Tight Under Every Operating Condition or Pressure up to 6000 Lbs.

Williams-Hager Flanged Silent Check Valves completely eliminate "Hammer" and "Bang" in the lines, provide uninterrupted constant flow of liquids.

Unlimited in size or application, from 1" to 20", built of materials to best suit the end use, Williams-Hager Flanged Silent Check Valves have been chosen for years as standard equipment in such exacting line uses as oil, gasoline, acids, water, chemicals, gas, air, salt water, brine, etc., regardless of temperature.

Write today for YOUR copy!

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

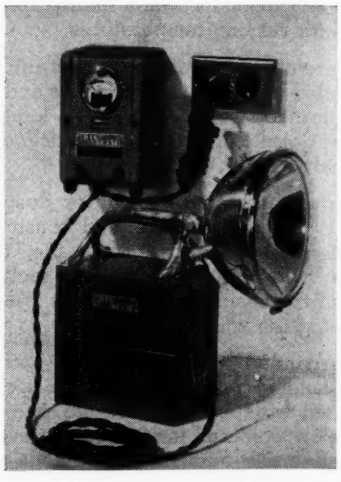
3000 PENNSYLVANIA AVENUE • PITTSBURGH 12, PA.

stub end of the rod to be projected into the proper position for welding.

The new Hollup "Shortstub" holder, completely insulated, loads and unloads quickly and because of its excellent balance and light weight, minimizes operator fatigue with practically complete use of valuable electrode metal.

Portable Electric Hand Searchlight

BIG BEAM No. 411 Portable Electric Hand Searchlight, made by U-C Lite Manufacturing Co., 11 E. Hubbard St., Chicago 11, Ill., will project an intense beam of more than 2500 ft or, by means of a snap-on lens, give the same volume of light over a wide area. The unit is



powered by a heavy-duty, shockproof 6-v storage battery, rechargeable from any a-c charger, d-c line or light plant.

The lamp head can be turned in any direction and stays adjusted. Perfectly balanced for carrying, either by hand or with shoulder-strap. Can be set almost anywhere, and by use of a hold-down can be securely anchored to any flat surface.

Flame-Resistant Gaskets

THE SHERWIN-WILLIAMS Co., 101 Prospect Ave., N.W., Cleveland, O., has developed a new type gasket, consisting of a felt base, impregnated with a chromate pigmented compound which renders the material flame and fire-resistant as well as corrosion resistant. Originally intended as a substitute for low-pressure rubber gaskets required in marine ventilating systems, chromate gasketing has since demonstrated its usefulness in many other applications, including joint seals in water, fuel oil and Diesel oil systems as well as gasketing for air lock and refrigerator doors.

Chromate gasketing is flame and fire resistant to a high degree, thereby rendering it valuable when inflammable materials must be avoided. It can withstand relatively prolonged exposure to salt water without decomposition. It may be had either factory pre-cut or cut from sheet at the point of use without special tools.

Chromate gasketing employs as a base sheet material, a good grade of thoroughly felted, low shoddy content wool felt. The felt base is impregnated with a specially prepared chromate pig-

FOSTER REGULATION ENGINEERING

Saves Maintenance Time

for example:

1 Major overhaul, when necessary, without breaking the line

2 All bolts are *stud* bolts—easily loosened

3 Guide and spring easily replaced

4 Ground joint — no gasket required

5 Main valve accessible—easily reseated

6 Main valve seat ring replaceable

7 Pushrod removed from lower end

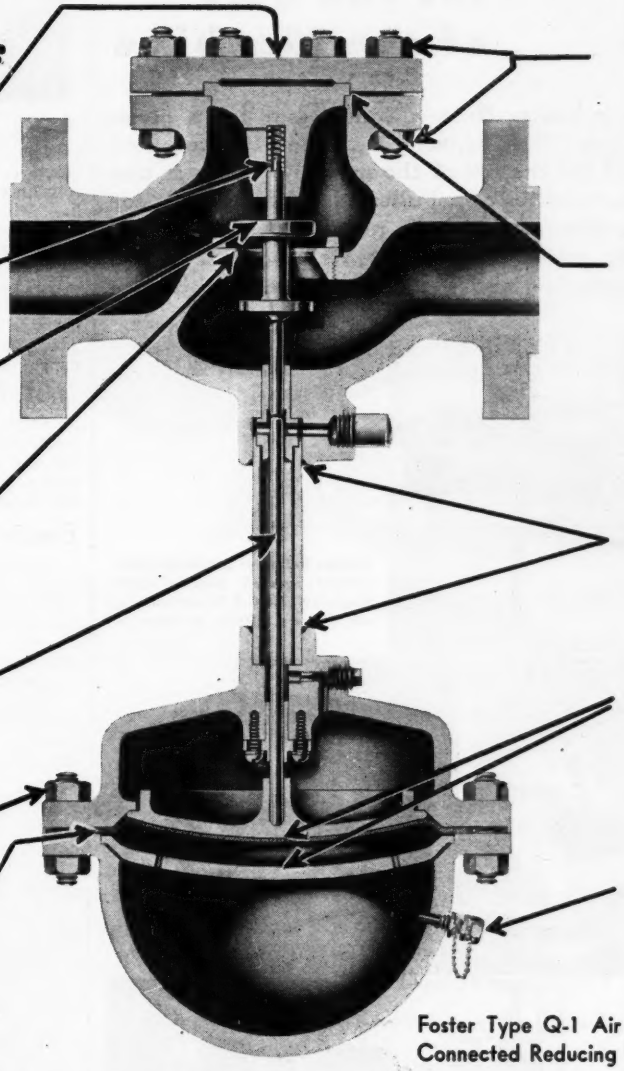
8 Brazed — no packing required

9 All smooth contact surfaces for diaphragm

2 All bolts are *stud* bolts—easily loosened

10 Diaphragm unit can be removed without disturbing rest of valve

11 Air fitting replaceable



Foster Type Q-1 Air Dome Loaded — Direct Connected Reducing Valve for Steam Service

Foster Regulation Engineering, built into each valve, is your assurance of years of accurate trouble free operation.

★ BUY MORE BONDS ★

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

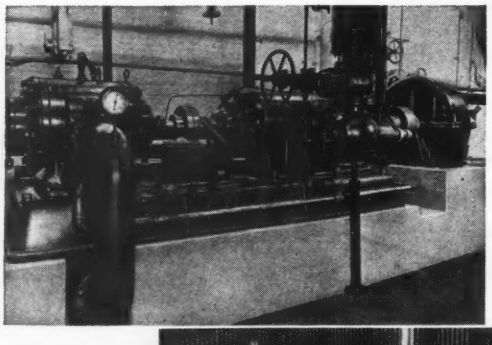
111 MONROE STREET • NEWARK 1, N. J.

3-FE-6

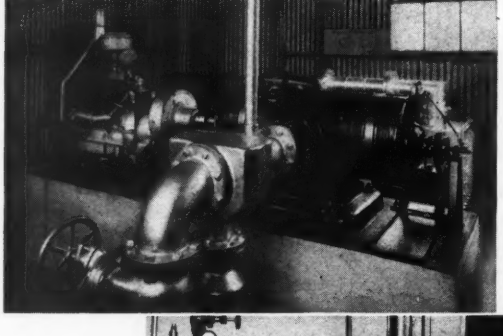
FULLER ROTARY COMPRESSORS

Continuous, Maintained Efficiencies for the Life of the Machine

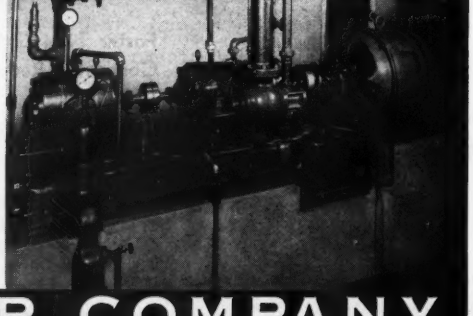
When you purchase a Fuller Rotary Compressor for a given capacity, you can expect that capacity . . . not for weeks or months or a year, but for the life of the machine. This is one of the inherent characteristics of a Fuller . . . they're built for just that kind of service. Only three moving parts: Rotor—Bearings—Blades. No valves to leak or seats to grind. Write for Bulletin C-5, illustrating and describing these machines.



Copper Refinery: Two-stage Compressor, geared turbine drive. Capacity 1775 C.F.M. actual free-air delivery, 100-lb. pressure.



Gas Industry: Single-stage Compressor, gas-engine drive. Capacity 756 C.F.M. actual free-air delivery, (1,088,640 cu. ft. per day).

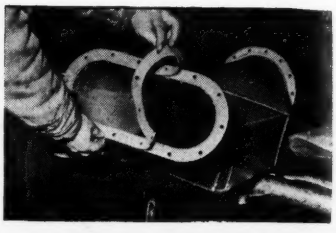


Valve Mfg. Plant: Two-stage Compressor, motor drive. Capacity 191 C.F.M. actual free-air delivery, 125-lb. pressure.

C-97

FULLER COMPANY
CATASAUQUA—PENNSYLVANIA
CHICAGO, 3 Marquette Bldg. WASHINGTON, 5, D.C. Colorado Bldg. SAN FRANCISCO, 4 Chancery Bldg.

mented compound which is non-drying, water insoluble and renders the felt flexible, pressure resistant and flame resistant. Because the compressibility of a chromate gasket depends considerably on the method of treatment, great care is taken with the impregnating operation.

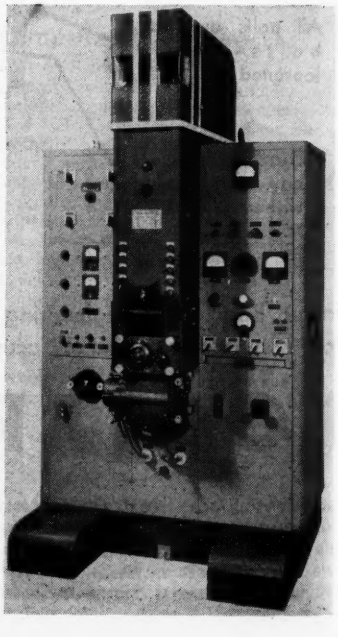


A chromate gasket will maintain air pressures up to 25 psi at normal temperatures. In addition to fire and flame resistance, it is not affected by fuels and has definite rust inhibiting properties. Chromate gasketing is dark green in color and is available in two thicknesses —$\frac{1}{8}$ in. and $\frac{1}{16}$ in. In addition to its original application for sealing joints in air ventilator lines, forced draft blowers and similar equipment, chromate gasketing may be used in flange-to-flange joints in drainage, fire main, fresh water, flushing, sprinkling, plumbing, fuel oil and Diesel oil systems. It may be employed for watertight or oiltight connections to structure and as gasketing for air lock doors, air lock relief valves, jointer doors, refrigerator doors and flame resistant closures.

Electronic Oscillograph

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburgh 30, Pa., announces the development of a new self-contained industrial electronic oscillograph which records characteristics of electrical phenomena lasting as little as a fraction of a millionth of a second.

The electronic oscillograph is an instrument of the cold cathode type capable of recording single electrical transients with respect to time, or two



FORGED FOR ENDURANCE...

LADISH FLANGES

- GRAIN FLOW CONTROLLED FOR MAXIMUM STRENGTH
- CORRECT RADIUS AT HUB FOR GREATER SAFETY
- FULL THICKNESS FACE PREVENTS DISTORTION
- ACCURATELY SPOT FACED FOR PROPER BOLT SEATING
- STEEL IDENTIFIED BY INDIVIDUAL HEAT CODE

TO MARK PROGRESS

There is no Substitute for Quality

Wherever flanges are used, the extra measure of safety and endurance that protects pressure piping systems against costly breakdowns is Controlled Quality.

Ladish flanges are produced under exacting metallurgical control and each bears the symbol of Controlled Quality identification . . . the Ladish Heat Code.

ARMY-NAVY "E"

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

MILWAUKEE SUBURB

District Offices: Lincoln Bldg., New York City • Rockefeller Bldg., Cleveland • Peoples Gas Bldg., Pittsburgh • Sterling Bldg., Houston • Petroleum Bldg., Los Angeles

TOLD IN WORDS OF USERS

"BETTER CONTROL"

"These valves give us better control over a longer period and really hold the pressure. It is our opinion that this is the finest control valve on the market. We shall reorder as the occasion develops."

"WELL PLEASED"

"We are well pleased with the streamlined regulator. Its operation is so good we don't know we have it in the plant. When we need another regulator we'll buy a streamlined one."

"Holds Steady Delivery Pressure"

"We like the Streamliner for its high capacity (we have used it on CO_2 and air). Other valves have so many twists and turns that they have a high pressure drop. On our CO_2 job we were unable to get the required capacity 'til we tried the Streamliner."

"LARGE CAPACITY"

"We like the '1000' valve very much due to its large capacity and perfect holding of reduced pressure right at point valve is set to deliver."

"Plenty of Closing Power"

"We needed a valve with plenty of closing power for use on dirty steam. Your large diaphragm valve gives tremendous closing power. The valve is easy to clean. The service has been very good."

"DEPENDABLE"

"This valve is the most dependable of any regulators we have ever used. Why, about two years ago I had a rush steam reduction job and had no valve for this spot. I had a 1000 air regulator with composition seat and rubber diaphragm that I put in. It's been in ever since and doing a swell job."

"FREEDOM OF FLOW"

"I bought this valve because I liked the freedom of flow and its being able to pass off scale and dirt. Keeping this off the diaphragm, I could see how the valve would always be very sensitive. It has been proven to me just what it will do and I am sold. When you set them they sure do stay."

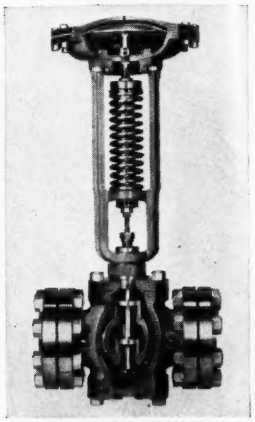
CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000

Type 1000-HP normal size diaphragm. Made for delivery pressures over 30 lbs.

Type 1000-LP has large diaphragm. Made for delivery pressures under 30 lbs.

A. W. CASH COMPANY
DECATUR, ILLINOIS

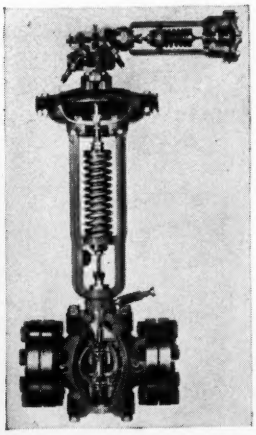
OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 34 Pressure Reducing Valve. For practically all fluids. Has roller bearing, also roller guides that kill side strains and stop packing trouble—no lost motion.

Sizes: ½" to 12" inclusive. Highest initial pressure 800 lbs.; reduced pressure vacuum to 150 lbs. Bodies: iron, bronze, steel. Trim: iron, bronze, stainless steel. Ends: screwed, flanged, ammonia type, welding type. Bulletin 968.

☆



Cash Standard Type 30-AP Valve gives precise control of fluid pressures, through a pilot connected to the pressure under control. For steam, water, air, and most fluids.

Can be a pressure reducing valve or a back pressure valve depending on the way the control lines are connected. Pressures up to 600 lbs. Sizes ½" to 12" screwed; 1" to 12" flanged ends; wide variety of metals.

☆

Engineering problems are something like bull dogs. If you don't know how to handle them they're tough . . . mighty tough. But if you have the know-how there's no question as to who is the master—you or the problem.

J. F. Pritchard and Company engineers have the know-how for solving and executing the more perplexing problems. Their experience in designing, engineering and constructing some of the most outstanding projects during the past several years is definite proof of their unchallenged ability.

Petroleum—Chemical—Petro-Chemical—Natural Gas—Power—Cooling Towers—no matter what the job, Pritchard Engineers can be of *real* service to you . . . today and tomorrow . . . for what they do today is dependable tomorrow. J. F. Pritchard and Company, Fidelity Building, Kansas City 6, Missouri.

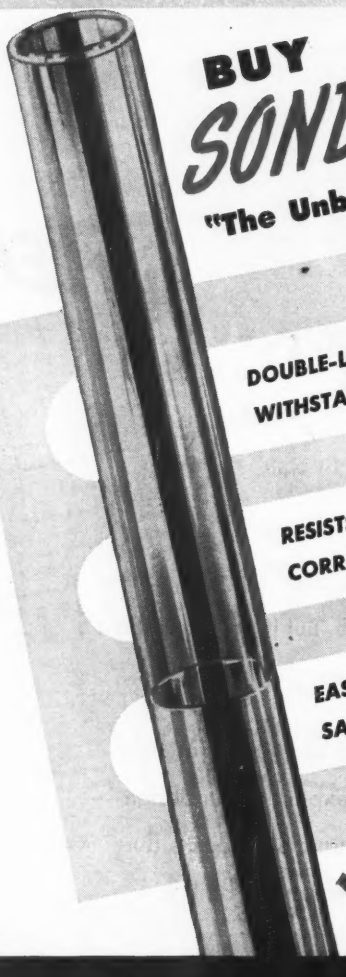
KANSAS CITY
TULSA
CHICAGO

Pritchard

HOUSTON
NEW YORK
PITTSBURGH

ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

IN FIRST COST OR REPLACEMENTS
YOU *Pay for the Best...*



BUY
SONDERGLASS
"The Unbreakable Gauge Glass"

DOUBLE-LAYER CONSTRUCTION
WITHSTANDS HIGH PRESSURES

RESISTS CLOUDING AND
CORROSION

EASIER TO SEE
SAFER TO USE

✓Order from Your Steam Supply Man or Directly from Us.

A. W. CHESTERTON CO.
64 INDIA ST. · BOSTON, MASS.
DISTRIBUTORS IN PRINCIPAL CITIES

SAVE COAL

KEEP BOILER TUBES CLEAN WITH A VIBRATAP

Fire Tube Model

Regular use of the Brunt VIBRATAP Cleaner to remove soot and scale means that tube surfaces are clean—able to assure maximum heat transfer —make your coal pile last longer. Write for descriptive Bulletin V-16 showing fire-tube and water-tube models.

BRUNT EQUIPMENT CO. 59 S. DIVISION STREET BUFFALO 3, NEW YORK

electrical phenomena with respect to each other, such as voltage versus current, in the form of diagrams produced by two pairs of electrostatic deflecting plates disposed at right angles to one another. The cathode of the tubes is energized from a 50 kv d-c rectifier with a control to correct for line voltage variation. The beam is normally blocked by a target. An impulse synchronized with the phenomena will trip the relay which bends the beam around the target so that it will strike the fluorescent screen or film below.

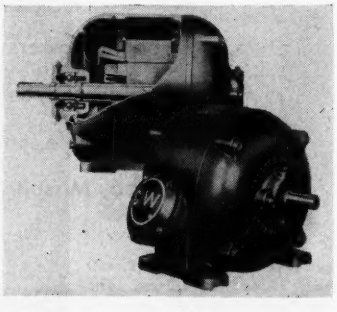
The new streamlined unit consists of the oscillograph proper in front of the cabinet and the cabinet proper which houses all energizing and control circuits. Energizing terminals are enclosed except one bushing conected to the source of synchronizing impulse. Concentrating coils, beam current meter, and leak valve, control the intensity and size of the trace on the film. Deflecting coils move the zero position of the beam so as to use the whole area of the exposed film for the record.

In addition to the fluorescent screen for direct observation, the instrument contains a stationary film holder taking a standard film for recording electrical phenomena lasting 1/1000 of a second or less, and may be operated with a rotating film drum for penomena lasting from 1/1000 to 1/10 of a second. A photoelectric control which makes it possible to take an oscillogram in one revolution of the drum, regardless of speed, eliminates the possibility of superimposed waves.

Protected Type Motor

Crocker-Wheeler Division of Joshua Hendy Iron Works at Ampere, N. J., has developed a new motor, combining the surplus capacity of the conventional open motor with protection against dripping liquid, falling metal chips and other foreign matter.

Rated 40 C rise, full-load continuous duty, these motors are available in sizes up to and including the 284 frame. Mounting dimensions conform to the standards of the National Electrical Manufacturers Association.



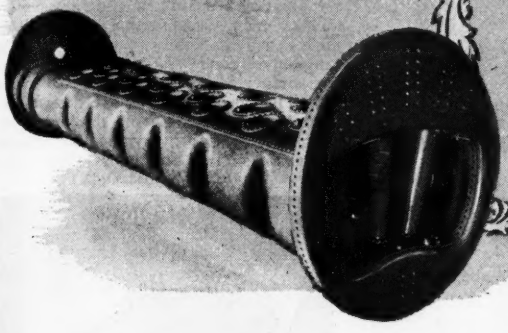
There are no openings in the frame or shields above the horizontal center line. This, together with the shielded construction of the ventilating openings, makes Protected-Type Motors suitable for machine tool and similar applications where other types of enclosures have been required in the past.

Centrifugal seals permit use of softer grease for better lubrication and longer bearing life. Rotor construction, in which the bars, fans and end rings are cast in one operation from aluminum alloys, is employed.

Other features of these many-purpose motors include: heavy cast frame

Since 1878...

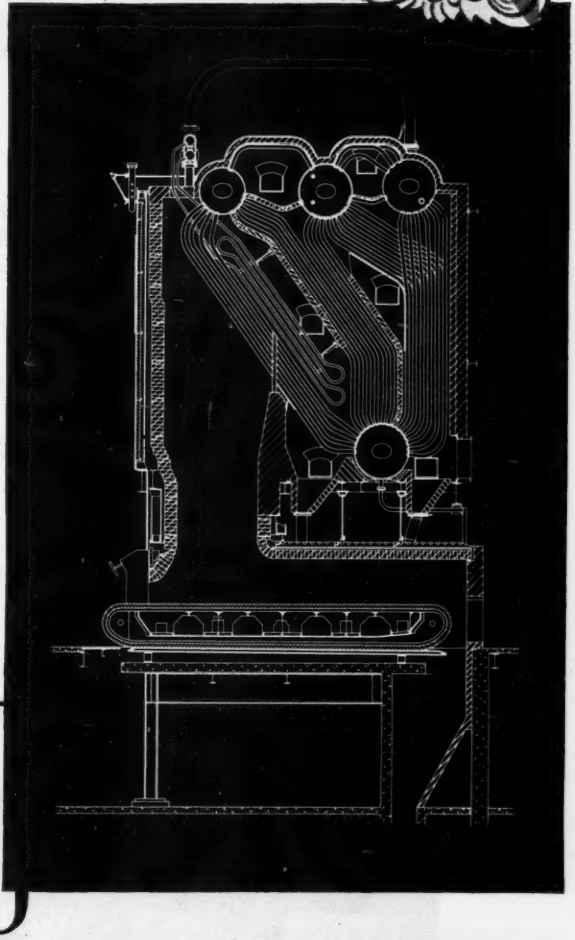
Steam Generating Equipment by EDGE MOOR



How many power engineers can identify the illustration at the left? It is the internal flue of an "Improved Galloway Boiler," an outstanding type in its day. Edge Moor began building Galloway boilers in 1878—and have been engaged in designing, developing and building steam generating equipment ever since.

Back of every Edge Moor installation of today there is the wealth of experience acquired through 67 years of boiler building—a cumulation of skills, methods and knowledge that enables Edge Moor to build boilers as outstanding in performance as were the Galloways in the days of the previous century.

Edge Moor boilers are designed for any required capacity and up to 900 lbs. drum pressure. Complete steam generating units, auxiliary equipment and installation service are available including boilers, superheaters, water walls, economizers and air preheaters. The combination of Edge Moor engineering experience and manufacturing control assures the ultimate in power plant performance.



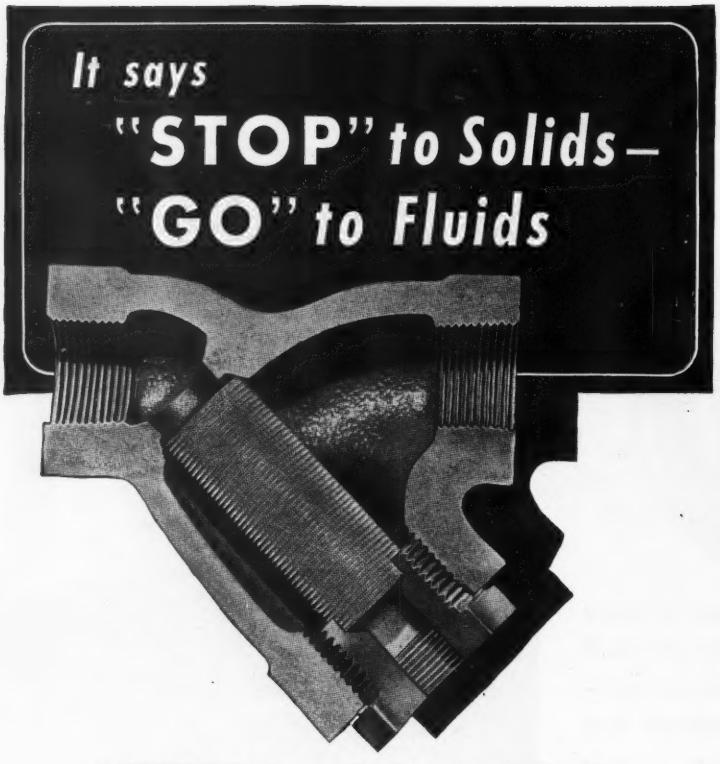
Edge Moor bent tube boiler with pendant interbank superheater and travelling grate stoker. Capacity 47,500 lbs. steam per hour; Drum Pressure, 275 psi; Degrees of Superheat, 180° F.; Final Steam Temperature, 585° F.

STEAM GENERATING EQUIPMENT

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

EDGE MOOR IRON WORKS, INC.

MAIN OFFICE AND WORKS: EDGE MOOR, DELAWARE



A BETTER Strainer to "police your pipelines"

- **FIRST—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.**
- **SECOND—*Finish*. Cadmium plated inside and out for protection against corrosion.**
- **THIRD—*Easily Cleaned*. Blow-off bushing made for easy removal. Bushing and Screen come out together. Screen automatically aligns on reassembly.**
- **THOUSANDS IN SERVICE—Sold by over 100 Mill Supply Houses.**

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-200.

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

construction, coils protected by Vinyl Acetal insulation, interchangeable front and rear shields, and specially designed guides for directing cooling air over all surfaces.

Standard Surface-Roughness Specimens

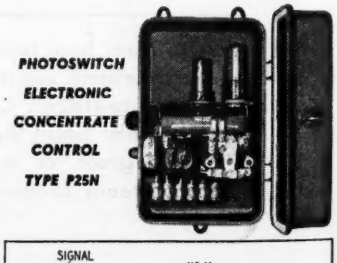
SPECIAL PRODUCTS DIVISION of the General Electric Co. has announced a set of standard surface-roughness specimens, each representing one clearly identified degree of surface roughness ranging from the smoothness of a bearing surface to the roughness of a flame cut. The new specimens are designed to permit the engineer or draftsman to select and specify by symbol the especial degree of surface roughness allowed for

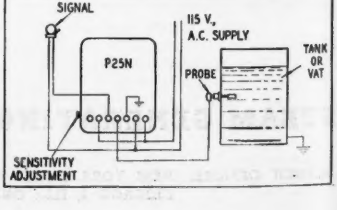
a particular machine part. They are also desirable for use in the shop to enable the mechanic to determine the exact surface roughness allowed by drawings.

The set consists of ten metal specimens each approximately 2 by 2½ by ⅛ in. in size. Several of the specimens are divided into two and in some cases four surfaces, all of which, while equally rough, are produced by different machining methods. In all, the ten specimens simulate 25 surfaces, each surface representing the roughest one acceptable for that particular symbol regardless of the method of producing the finish or the material of which the part under inspection is made.

Control Checks Liquid Mixtures

PHOTOSWITCH INCORPORATED, Cambridge, Mass., announces an electronic concentrate control for detecting and





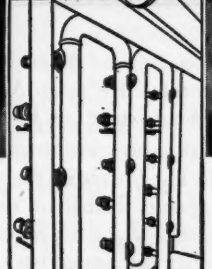
Maximum Flow Efficiency in Branch Outlets at LOW COST

WeldOlets are available in three types—Welding Outlet, Threaded Outlet and Socket Outlet.

Where pressure losses in branch pipe outlets must be kept to a minimum and flow efficiency is important, WeldOlets are a must. The patented, funnel-shaped opening which they provide into the branch pipe eliminates turbulence and keeps friction to a minimum.

WeldOlets have also proven their worth where you need the strongest possible right-angle, welded branch pipe outlet . . . in the least amount of time . . . and . . . at the lowest possible cost.

WeldOlets are made in size-to-size and reducing sizes for standard pipe sizes up to 24" and for pressures up to 400 lbs. at 750°. Men responsible for piping will want to know more about the WeldOlet method of making branch pipe outlets. Illustrated catalog with complete application and installation information will be sent on request.



WeldOlets played an important part in the installation shown here. This is part of the air conditioning system in one of the largest federal buildings.

Forged Fittings Division

BONNEY FORGE & TOOL WORKS • 639 N. Meadow St., Allentown, Pa.

WELDOLETS

TRADE MARK REG. U. S. PAT. OFF. PAT. IN U. S. & FOREIGN COUNTRIES

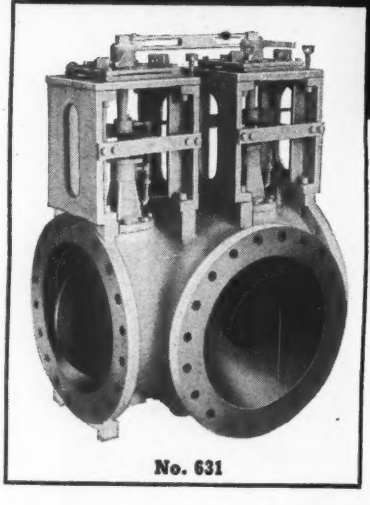
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET

For Welded Branch Pipe Outlets

No. 630

15 to 900 psi
Control and shut-off of volume and pressure for air, gas, steam, liquids and semi-solids

TORQUE IS EQUALIZED in *Quick Operating* Three-Way Valves



No. 631

All R-S Butterfly Valves are precision engineered, metallurgically and mechanically, and this is the chief reason why the Three-Way Valves have met widespread approval and acceptance.

Designed for mixing and quick interchange service, these valves are adapted to pressures from 15 to 900 psi and for elevated or sub-zero temperatures. In manual operation, four to six revolutions of the hand wheel fully open or close the valve vane. Adjustable linkage is usually provided so that the mixture can be changed at will.

With a pressure drop across the valve, the vane tends to close itself. The torque on the closed right-hand vane (see illustrations) is opposite to that on the open left-hand vane so that the torque is equalized and no excessive load is placed on the prime mover whether the operation is manual or automatic.

Available in sizes from four to sixty inches. Write for details and Catalog No. 14-B.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. • Philadelphia 44, Pa.

R-S *Streamlined* BUTTERFLY VALVES

controlling, through operation of signals, valves or pumps, changes in liquid concentrations. This electronic method provides precise and accurate control for all applications in which changes in concentration are accompanied by a corresponding change in electrical conductivity.

Installation is made quickly and easily and requires only that a probe fitting be mounted on the tank, with probe extending into the liquid. This probe is wired to the electronic control which may be located wherever desired. An adjustment on the control housing is set so that the control relay will operate when liquid of a predetermined electrical resistance contacts the probe. While the probe is immersed in liquid of any other resistance, the control remains inoperative, but when a change in concentration alters the conductivity of the liquid to the necessary degree, the electronic control relay is energized to operate signals, valves or pumps.

Obituaries

Alfred C. Marshall

ALFRED C. MARSHALL, director, consultant and chairman of the operating council of The Detroit Edison Co., died February 9, at Harper Hospital, Detroit, following a short illness. His death was caused by an injury received from a fall which occurrred on January 28. In May, 1944, Mr. Marshall retired as president of Detroit Edison, a position he had held since 1940.

He was born in Middletown, Ohio, September 26, 1872. He was educated in the Detroit public schools and graduated from the University of Michigan in 1893 with a Bachelor of Science degree in Electrical Engineering. In 1932, the University of Michigan conferred upon him the honorary degree of Master of Science in Engineering. Wayne University honored him in 1943 with a degree of Doctor of Arts in Business Administration.

Mr. Marshall was first employed by the Public Lighting Commission of the City of Detroit from 1894 to 1899. In 1899, he became chief engineer of the Rapid Railway System and left this organization in 1904 to become an engineer on construction work for The Detroit Edison Co. He was appointed general manager of the Port Huron Light and Power Co. in 1905, and in 1911, he was elected assistant to the president of the Eastern Michigan Edison Co. He became a vice-president of The Detroit Edison Co. in 1913, and in 1923 was made general manager. In 1940, he became president and general manager. From March 16, 1943, to May 16, 1944, he served as president and retired from this position on May 16, 1944. Mr. Marshall had been a director of The Detroit Edison Co. continuously since 1920.

H. M. Cushing

HARVEY MORSE CUSHING, for 22 years chief mechanical engineer for Buffalo Niagara Electric Corp. and one of the nation's authorities on steam power generation, died January 31, 1945, at his home, 149 Commonwealth Ave., Buffalo,

Acting with the speed of light

fireye

PREVENTS EXPLOSIONS

in oil and pulverized coal burners

Those first vital seconds following flame failure can determine whether you'll still have a boiler . . . *or an explosion.* Why? Because fuel, under pressure, can fill the combustion chamber very, very quickly, changing it from an efficient heating apparatus to a powerful bomb crowded with a highly explosive mixture. A stray spark, hot refractory, or the simple act of relighting under these conditions may easily result in serious damage and loss of life.

Fireye acts with the speed of light to prevent explosions in oil and pulverized coal burners. Rays from the flame itself are focused directly upon Fireye's sensitive photoelectric cell. Should the flame fail, Fireye will react instantly to shut off the fuel . . . sound an alarm . . . or energize a complete programming relay for fuel pump and valve operation.

F-3

For full details write for Catalog 50
. . . on your letterhead, please.

★ ★ ★

FIREYE ELECTRONIC BOILER FEEDWATER CONTROLS are floatless and maintenance-free. They maintain desired water level automatically — provide low-level alarm and fuel cut-off. Write for Catalog 51.

What it is . . . . What it does

The photoelectric cell of Fireye observes pilot, main flame or both through a small window in the wall of the fire chamber.

Fireye equipment is a self-contained unit of proved performance, easily installed — a moderate investment that is paying a high return in greater safety in installations throughout the country.

COMBUSTION CONTROL CORPORATION

Cambridge 42, Mass. · District Offices in all Principal Cities

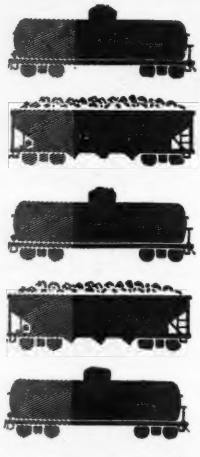
PHOTOELECTRIC fireye **FLAME SAFEGUARD**

A Fuel Saving Method THAT IS SIMPLE AND DEPENDABLE

Of all the plans, products and methods advocated as fuel-savers, Enco Streamline Baffles represent one of the simplest and most dependable means available.

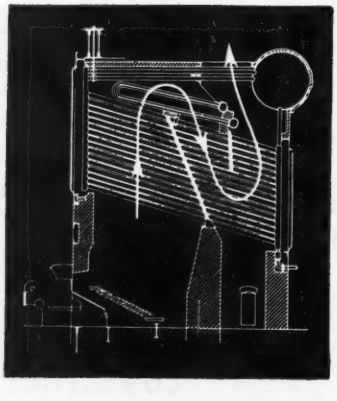
They are easily put to work because they are adaptable to any type of water-tube boiler—and the entire job can be turned over to this company.

Dependable because they are designed on sound engineering principles, backed by The Engineer Company's quarter-century of experience in this field. Baffles are individually designed to meet the requirements of each boiler. Installations are made by our mechanics whose skill in this work is unsurpassed.



A Booklet Worth Having

Details of these baffles, with descriptions of novel and ingenious constructions used in numerous types of boilers are available in this booklet. It is looked upon by many engineers as a reference book of real value. Your copy will be sent on request.



THE ENGINEER COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

Canada: F. J. Raskin, Inc. • 370 Rachel E., Montreal, P. Q.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

N. Y., after an illness of several months. He was 69 years of age.

Mr. Cushing had been associated with Buffalo Niagara Electric and predecessor companies since 1915 when he joined the Buffalo General Electric Co. as chief mechanical engineer. Upon his appointment as chief engineer January 1, 1922, Mr. Cushing was in complete charge of all electrical, mechanical and structural designing, drafting and construction for the company.

He was born in Rockford, Ind., December 5, 1875. After finishing high school, he attended Massachusetts Institute of Technology, at Boston, where he graduated in 1899 with a degree of Electrical Engineer. Upon leaving MIT he had charge of the installation and operation of the 100 kw dynamo, motor and lighting equipment in the Janney Mfg. Co.'s new factory at Ottumwa, Iowa. In January, 1900, he began as a tester in the Dynamo and Motor Department of the Western Electric Co., Chicago plant, and 6 months later joined the General Electric Co. at Schenectady.

Mr. Cushing went to Buffalo in January 1910 as sales engineer in charge of the Buffalo District for General Electric. He divided his time between sales, and installation work and complaint problems. He left the General Electric Co. in December 1914 to join the Buffalo General Electric Co. Since 1941, he had been a Consulting Engineer for Buffalo Niagara Electric Corp.

Lewis E. Myers

LEWIS E. MYERS, 82, public ultilities executive, philanthropist, and former president of the Chicago board of education, died on February 5 in his apartment in the Blackstone Hotel in Chicago. Mr. Myers, a native of Pittsburgh, started his utility career with the Edison Electric Co. in that city in 1886, went to Chicago in 1890 to head the Chicago office of the Detroit Electric works and shortly afterwards organized the L. E. Myers Co., builders and operators of public utilities. He was on the board of the Salvation Army for 25 years, the last 15 as chairman.

William Hubeli Waldron

WILLIAM HUBELI WALDRON, vice-president and director of the John Waldron Corp. of New Brunswick, N. J., died at his home in that city on February 1 in his 80th year. He was the grandson of William Waldron who founded the business in 1827 and the son of John Waldron for whom the present corporation was named. He became associated with the John Waldron Co. in 1885 and was active in its management until 1924 when the present corporation was formed. Mr. Waldron was graduated from Rutgers University of which he later became a life trustee and a vice-president. He was also director of the National Bank of New Jersey and of the Interwoven Stocking Co. and numerous other corporations as well as manager of the New Brunswick Savings Institution.

Eshelby F. Lunken

ESHELBY F. LUNKEN, president of The Lunkenheimer Co., Cincinnati, Ohio, died on January 25, of a heart attack, at the age of 54 years. He was a leader in business and civic affairs and was actively interested in aeronautical development, having been instrumental in the establishment of the Lunken Airport. He was the son of Edmund H. Lunken, who at the time of his death in July, 1944, was chairman of the board.

SOME INSIDE BOILER FACTS

The interior surfaces of this high pressure boiler have been coated with tough, durable, APEXIOR No. 1

The next time your boiler is down, compare how it looks with this one

When you coat the interior metal surfaces of your boiler with APEXIOR, here's what happens:

1. A film of safety seals the open structure of the boiler metal. This film of safety is corrosion-proof because it is non-metallic, therefore the present condition of the boiler steel is improved and maintained.
2. Dirt and scale do not adhere as tightly to APEXIOR as to bare metal, because any bond between scale-forming solids and APEXIOR is easier to break, as it is a purely mechanical, not a chemical bond.

APEXIOR NUMBER 1 is brush-applied, manually or by power-coater. High boiler pressures or ratings, or chemical treatment of boiler water, do not affect APEXIOR NUMBER 1. The total thickness of the coating is .0025". Heat transfer is not retarded.

Recommended by Insurance Companies

APEXIOR NUMBER 1 is recommended by boiler insurance companies. Steam turbines are being delivered to users with shafts and rotor bodies APEXIORIZED. The supplier of your turbine may be one of those following this procedure of added protection.

So when you're thinking in terms of higher production and maintenance standards, start with the heart of your plant, your boiler. APEXIORIZE it.

For "Cold-Wet" Metal Surfaces— APEXIOR No. 3

Wherever you have tanks or metal surfaces exposed to water or moisture at any temperature under 125°F. — protect them with APEXIOR NUMBER 3. This special, shiny-black paint on metal is resistant to cold water, fresh or salt.

Organizations like these have used* APEXIOR *for years

Brunswick Marine Construction Co.
The Franklin Sugar Refining Co.
Hudson Motor Car Company
American Can Company
Oxford Paper Company
Savage Arms Corporation
Philadelphia Electric Co.
Union Electric Light & Power Co.
State Hospital, Morganton, N. C.

APEXIOR

Keeps new metal new . . . Gives old metal new life

The DAMPNEY COMPANY of America
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Massachusetts

Please send free Bulletin 1290.

Name.....

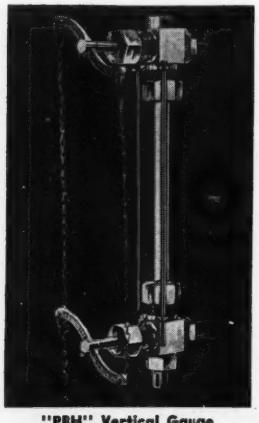
Company.....

Address.....

Precision Made
HUYETTE WATER GAUGES

Meet ASME Code...

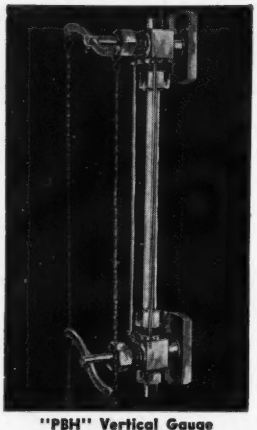
All Huyette water gauges are quick closing... well proportioned and made of bronze mixture according to ASME Code... and stamped with maximum working pressure. These features assure you of meeting today's demands for equipment that will last long and give 24-hour-a-day service.



"PBH" Vertical Gauge (Screwed connection)

Assure Steam-Proof Service...

Because the glass and steam nuts are large to accommodate ample size packings, "PBH" insures steam-proof service. The gauges are opened or shut by less than a quarter-turn—providing quick, efficient shut-off of danger and expense.



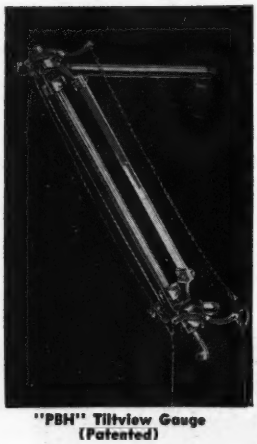
"PBH" Vertical Gauge (Flanged connection)

Give Leak-Tight Service...

Leak-tight service is also provided by Huyette Water Gauges. This provides saving and more efficiency. All valves are rigidly tested and inspected before leaving our factory.

Interested?

For complete details and specifications on all "PBH" water gauges, sizes, working pressures and pipe connections, write for Bulletin No. 741. Contains useful charts, tables, photographs. Write today.



"PBH" Tiltview Gauge (Patented)

The PAUL B. HUYETTE COMPANY, INC.

Established 1896

401 N. BROAD ST., PHILADELPHIA 8, PA.

MANUFACTURERS' *News*

The Optimus Detergents Co. has been organized and is in operation at Matawan, N. J., manufacturing industrial detergents and developing new cleaning methods for industrial use in its research laboratory and pilot plant.

This company will also have available the facilities of its associate, Optimus Equipment Co., so that cleaning methods to be followed can, where needed, be utilized and developed with the aid of specialized cleaning equipment.

The Optimus Detergents Co. and Optimus Equipment Co. function in close affiliation with the Hanson-Van Winkle-Munning Co., also of Matawan, N. J.

F. E. Schluter, President of Thermoid Co., Trenton, N. J., has announced plans to purchase Grizzly Manufacturing Co.'s West Coast plant and equipment located at Los Angeles, Cal. The purchase will include the complete line of Grizzly oil field, industrial rubber and aviation products and all patents covering those products — including inventories and accounts receivable. Walter Smith, Vice President and General Manager of Grizzly Manufacturing Co., will continue for a limited time as manager of the Los Angeles plant.

This acquisition will supplement Thermoid's lines of industrial rubber and oil field products. All Grizzly industrial rubber products—such as air hose, steam hose, suction hose, packings, transmission belting and conveyor belting—which had to be discontinued for war production—will be manufactured in the Los Angeles plant after V-E Day.

H. E. Lewis, President of Jones & Laughlin Steel Corp., has announced the purchase from Talon, Inc., of their electric welded tube plant, at Oil City, Pa.

The plant has facilities for producing electrical welded mechanical and pressure tubing in sizes ⅝-in. to 4-in. outside diameter, inclusive. Its products will supplement Jones & Laughlin's present line of seamless, lap-welded and buttwelded tubular products.

The new acquisition will be known as the Electric Weld Tube Division of Jones & Laughlin Steel Corporation and will be operated with present personnel.

Purchase of the Pixley Electric Supply Co., 226 N. Fourth Street, Columbus, Ohio, by the Westinghouse Electric Supply Co. was announced recently.

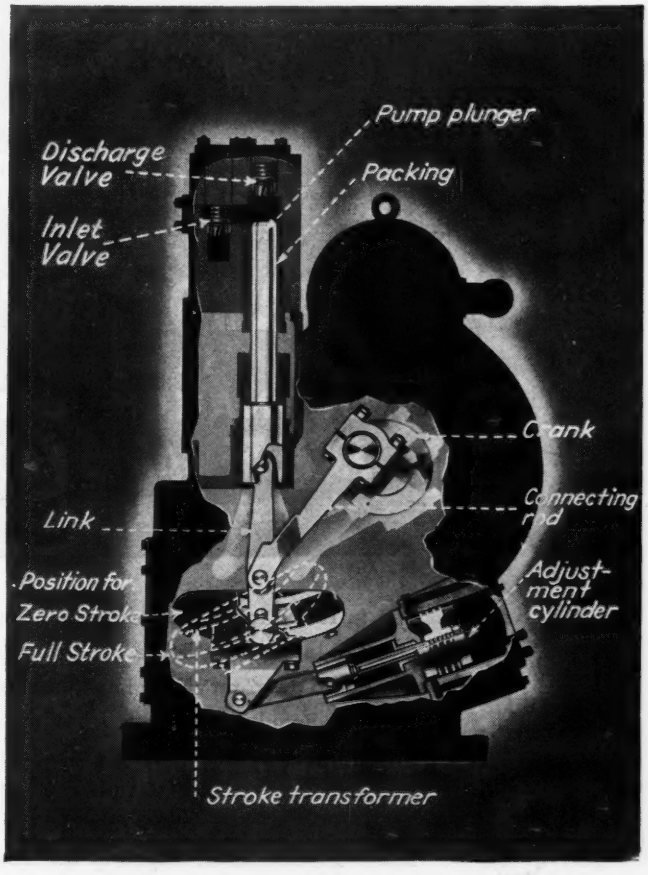
The Columbus concern, a wholesale distributor of electrical products, has been made the headquarters for a new Wesco territory, designated the West Central District. Manager of the new district, which also embraces Wesco outlets in Cincinnati and Evansville, Indiana, is L. A. Pixley, who formerly was President of the Pixley Electric Supply Co.

The General Electric Co. has announced that ten commercial vice-presidents, representative of every sales district of the company in the United States, will relinquish their re-

Here's why ALDRICH-GROFF "POWR-SAVR" PUMPS *actually* SAVE POWER

In medium and high pressure services—

- ***Boiler Feeding***
- ***Desuperheater Feeding***
- ***Process Charging***
- ***Pipe Line Pumping***
- ***Hydraulic Pressure***



Length of plunger stroke is governed by position of stroke transformer. At zero delivery, link has pendular motion and plunger does not move. As stroke transformer is rotated toward full delivery position (shown by dotted lines) vertical component of linkage increases until full stroke is obtained. Thus, no change in pump speed is required to vary pumping capacity.

Because these unique constant-speed variable-delivery pumps are designed to afford flexibility of capacity so that power consumption is practically proportional to delivery demands, substantial savings are assured. And, a self-contained dustproof lubrication system automatically provides oil supply under constant pressure to all bearing points —assuring continued high efficiency and low maintenance expense.

Where it pays to invest money for the efficient combustion of fuel and generation of power, or for economical process equipment, it is equally important and financially attractive to utilize power with a comparable degree of efficiency. It is the function of the ALDRICH-GROFF Pump to most efficiently utilize pumping power, particularly where variable rates of pumping are involved.

These pumps may be automatically or manually controlled from any remote point of control to provide stepless straight line variation ranging from zero to full delivery. They are adapted for operation with any standard automatic controller of the "air pilot" type responsive to variations in liquid level, flow, temperature, pressure or other desired conditions.

Now available in six standard sizes ranging up to 100 B.H.P. and for pressures up to 15,000 PSI, ALDRICH-GROFF Pumps are being increasingly used wherever power savings, extreme mechanical reliability and simple accurate control of delivery is important. Since being announced in 1939, more than 300 of these pumps have been placed in varied services and have established enviable performance records under severe and exacting service conditions.

For a more detailed description of ALDRICH-GROFF principles write for Bulletin 65.

ALDRICH

THE ALDRICH PUMP CO. ALLENTOWN, PENNA.

REPRESENTATIVES: Birmingham • Bolivar, N.Y. • Boston • Chicago • Cincinnati • Cleveland • Denver • Detroit • Duluth • Houston • Los Angeles • Pittsburgh • Portland, Ore. • St. Louis • San Francisco • Seattle • Tulsa

HENSZEY
BOILER FEED
REGULATORS
on
GUARD DUTY
in an
ORDNANCE PLANT
DAY** after **DAY
since 1942

Yes, in 1942 a large southern ordnance plant ordered 16 Henszey Boiler Feed Regulators for "guard duty" on vitally important boilers. Henszey Regulators maintain proper boiler water levels continuously, automatically and accurately under all local conditions. They are easily installed right in the feed line — no additional supports are needed. And did these Henszey Regulators do the job? You bet—so well that three more were recently added to the sixteen already in service.

Write for bulletin.

HENSZEY COMPANY
DEPT. C3 • WATERTOWN, WIS.

HENSZEY
BOILER FEED REGULATORS
Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves

sponsibilities for apparatus sales and become members of the President's staff in order to co-ordinate the General Electric Company's widely diversified interests and afford better service to the company's wartime customers both military and those industries manufacturing war materials. In their new positions these men will report to Vice-President E. O. Shreve, in charge of customer relations with headquarters in New York.

Those affected by the change are: R. M. Alvord, of San Francisco; T. F. Barton, of New York; W. O. Batchelder, of Chicago; L. T. Blaisdell, of Cleveland; W. B. Clayton, of Dallas; E. H. Ginn, of Atlanta; A. L. Jones, of Denver; T. S. Knight, of Boston; A. S. Moody, of Portland, Ore.; and C. K. West of Philadelphia.

The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., honored the first two 50-year plant employees, Andrew N. Van Riper and Morris G. Fitts, at a dinner on January 25 at Mountainview, N. J., which was attended by approximately 500 persons. The dinner also marked the organization of the Manhattan Pioneers composed of employees who have been with the company 25 years or longer. This organization has a membership of 270 who are actively employed.

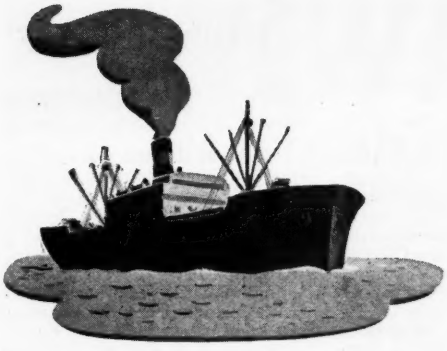
Link-Belt Co. has moved its Huntington, West Virginia, office from 2840 North Staunton Road to Suite 1301-1302 in the West Virginia Building, located at Fourth Avenue & 9th Street. Dave W. Stevens is district manager in charge of the office.

The C. J. Tagliabue Mfg. Co. of Brooklyn, N. Y., has sold its assets, including goodwill, name and patents, to the Portable Products Corp. of Pittsburgh, Pa. The business formerly carried on by Tagliabue will be operated as a separate division of the Portable Products Corp.

Kenneth W. Huffine, recently elected vice-president of the Johns-Manville Products Corp., will head up the newly organized Engineering Department of the Corporation. Formerly manager of the Johns-Manville plant at Waukegan, Ill., Mr. Huffine in his new capacity will be in charge of the new department at New York Headquarters created to consolidate engineering activities in the mining and manufacturing division to meet the production demands of wartime operations, and to expand plant engineering programs in preparation for post-war production plans of the company.

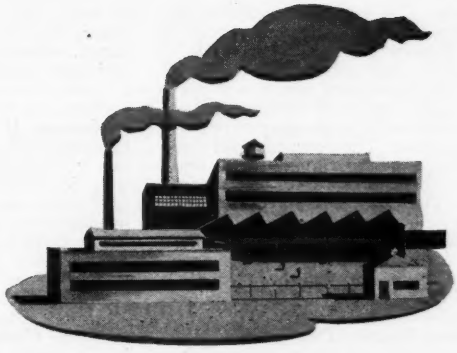
The Emery Floor Co., Inc., 330 West 42nd Street, New York, has been organized to lay industrial floor toppings where Cortland Emery Aggregate is used. This company is associated with Walter Maguire Co., Inc., and will operate in co-operation with established flooring firms, contractors, builders, plant maintenance departments and distributors of Cortland Emery Aggregate.

American Locomotive Co. has announced that Alexander M. Hamilton, vice-president in charge of foreign sales of the company has been named as president of the newly formed American Locomotive Export Co., Inc. The purpose of the new corporation is to facilitate the handling of foreign business in some countries where it is legally necessary to have such a



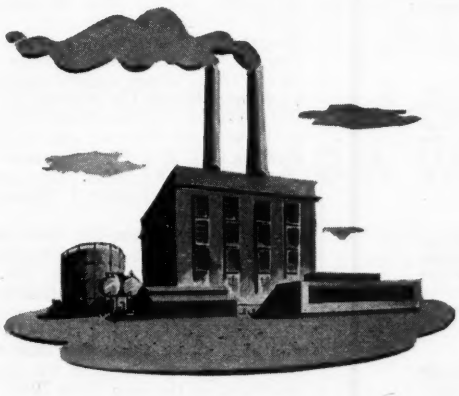
COOLER — CLEANER — LONGER LIFE

Early tube failure was traced to plug-type dezincification, with a change of metal indicated. But Scovill *Service in Metals* blamed unusually high temperatures and insufficient tube cleaning. Better operation lengthened life of replacement tubes many years.



LOCALIZED INFECTION CURED

Persistent failure of two rows of tubes in the first pass of a condenser was puzzling, because tubes in adjacent areas were normal. Scovill *Service in Men* helped the chief engineer work out an inexpensive construction change, ending the premature failure.



USEFUL TO UTILITIES

Scovill's Condenser Tube Booklet will be found in many a utility power plant — on industrial and marine engineers' desks, too — because it gives valuable information on metals, installation, analyzing trouble sources. It is part of Scovill's *Service in Manuals.*

Many power plant operators look first to Scovill for news on new developments... advice on installation practice... help in solving problems — because Scovill is

One Company Which Gives You

ONE PRODUCT

... Condenser Tubes

THREE SERVICES

For a free copy of the new Scovill Condenser Tube Booklet, write SCOVILL MANUFACTURING CO., 17 Mill St., Waterbury 91, Conn.

subsidiary. The export corporation is owned by American Locomotive Co.

The Hewitt Rubber Corp. of Buffalo, N. Y., has recently announced an expansion program which will permit increased output of conveyor belts, transmission belts and many types of industrial hose. The company will also enter the field of latex foam and molded rubber articles for use in industry. The new equipment at the main Buffalo plant more than doubles the pre-war capacity of mixing rubber and of forming the raw stocks into sheets. These are two basic operations in the manufacture of all industrial rubber products.

Gardner-Denver Co., Quincy, Ill., has established the main office of its Export Department in New York City in order to facilitate handling of its extensive export activities. G. V. Leece, vice-president of the company, will have charge of the entire Export Division with offices in the Woolworth Building in New York City.

George H. MacGilvray has been appointed district manager of the newly established New England District Westinghouse Lamp Division's field organization which will have headquarters in Boston where warehouse facilities have been provided at 145 Ipswich Street. Mr. MacGilvray will continue to supervise customer relations in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut from his former headquarters at 10 High Street, Boston.

RODA

High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE

Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal

Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W. Va., originating on the N. F. & G. R. R.

ANTHRACITE — Hazle Brook Premium
. . . Raven Run

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:

BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH

MANUFACTURERS' *Personals*

General Electric Co. has announced the following changes in personnel—New district managers of apparatus sales; C. E. H. Palmer, New England District with headquarters in Boston; W. J. Dorworth, of Philadelphia, the Atlantic District; C. L. Redd, of Birmingham, the Southeastern District with headquarters in Atlanta; C. W. Fick, of Cleveland, the East Central District; R. I. Parker, of Chicago, the Central District; H. A. White, of Dallas, the Southwestern District; F. H. Doremus, of Denver, the Rocky Mountain District; A. G. Jones, of San Francisco, the Pacific District; and J. R. Murphy, of Spokane, the Northwestern District with headquarters in Portland; T. F. Barton, of New York, will continue as the New York District manager. Harry E. Dunham has been appointed manager of the company's Patent Department; Harry R. Mayers, assistant manager of the Patent Department; Lawrence Jennings has been named assistant to E. O. Shreve, vice president in charge of customer relations; Ralph J. Cordiner, vice-president and assistant to the president.

Wilson A. Charbonneaux, associated with Burlington Instrument Co., Burlington, Iowa, for the past eight years as Chief Engineer and General Manager, left that company in October, 1944, and is now Manager and Chief Engineer of Automatic Control Engineers, of Burlington, Iowa, development engineers and manufacturers of electrical power control equipment.

Morse Chain Co., Division of the Borg-Warner Corporation, with plants at Ithaca and Detroit, announces the election of Walter W. Bertram as Vice-President in charge of sales, and the appointment of Robert J. Howison as Sales Manager.

A. O. Thalacker has been elected vice-president and general manager of Detrex Corp., Detroit, Mich. Mr. Thalacker joined the organization in 1937 and has held the executive positions of assistant secretary and secretary. The company also announced that E. W. Allison, who has been in the legal department of the firm since 1941 is now secretary.

Roland A. Wank has resigned as head architect of the Tennessee Valley Authority to join the designing staff of Albert Kahn, Associated Architects & Engineers, Inc. Previously he was in active charge of the TVA assignment which position he has held since 1933. Mr. Wank was also chief consulting architect of the Rural Electrification Administration.

Foster D. Snell, Inc., has announced that Dr. D. Gardner Foulke recently chief chemist for the Garfield Division of the Houdaille-Hershey Corp., has joined the staff of Foster D. Snell as director of the Analytical Department. He will have complete charge of the analytical work with the responsibility of developing necessary techniques for new and unusual types of analyses.

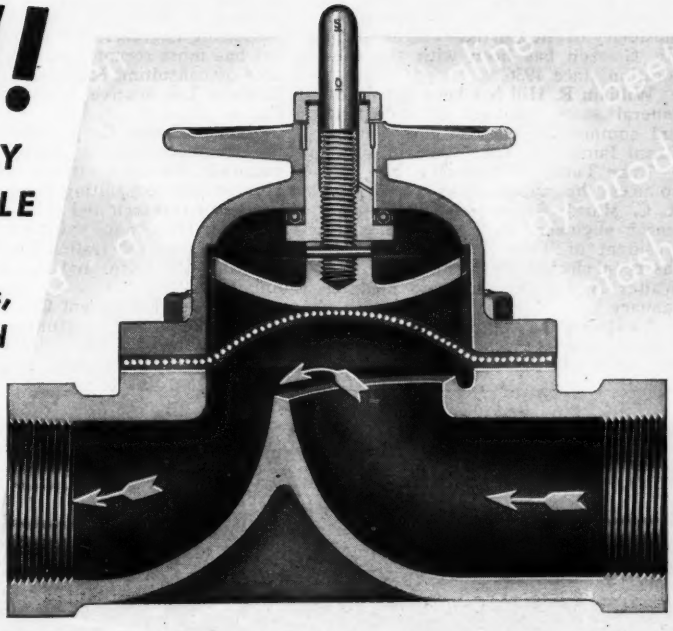
Curtiss-Wright Corp. has announced the appointment of W. W. Gleeson as vice-president and general manager of

NEW!

...PRACTICALLY INDESTRUCTIBLE

in Service with upwards of 100 Acids, Alkalies, Abrasives and Suspended Solids

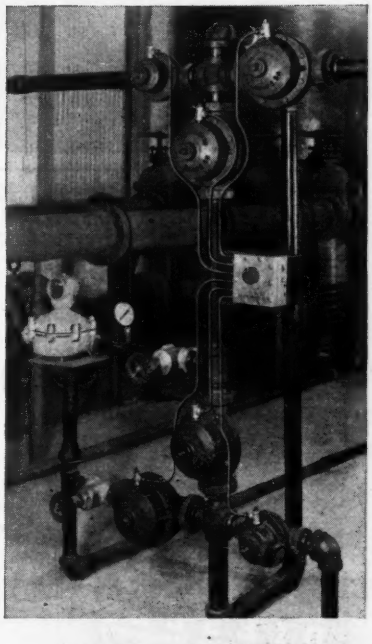
Available in 10 sizes, ½" to 6", Screwed or Flanged. In semi-steel or lined with rubber, glass or lead. Pressures to 150 lbs. Temperatures to 150° F. These valves are being extensively used to replace more expensive valves in chemical plants, industrial plants, mines, sewage disposal plants, water works, paint factories, paper mills, food processing and other industries. Hand-operated type at right; below, pilot-operated type controlling flow rate, backwash and rinse cycles in Mid-West industrial plant.

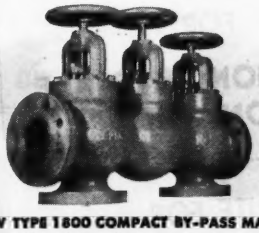


McALEAR

No. 1455 Corrosion and Abrasive Proof DIAPHRAGM VALVE

BECAUSE diaphragm completely separates fluids from working parts, mechanism of this valve is trouble-free—cannot freeze in outdoor service—and *no stuffing box or repacking* is required. Valve does *not* depend on metal-to-metal contact for closure. Hence *no leakage is possible* and *no reseating ever necessary*. Shape of weir prevents accumulation of solids—offers minimum resistance to flow—and *positive shut-off* is provided by diaphragm *even* when solids are trapped on the seat. Valve is installable *in any position* without danger of leaks. Suitable for on-or-off or for throttling service. Special types may be operated from remote points by air or water pressure, controlled by automatic timeclock or pilot. Write for McAlear Diaphragm Valve Bulletin.





H-W TYPE 1800 COMPACT BY-PASS MANIFOLD
Simplifies piping designs, eliminates a number of flanged or screwed connections, saves space, reduces leakage hazards without increasing installation costs. Sizes ½ to 4 inches. Bronze, cast iron, steel, union and bolted bonnets, screwed and flanged ends. Also silver braze and steel socket weld. Write for H-W Bulletin 117.

H-W McALEAR controls
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
for STEAM, WATER, AIR, OIL-GAS

IF YOU HAVE A CONTROL PROBLEM, **call on McAlear engineers. Draw on their fund of experience . . . on their readiness and willingness to help you develop special controls when *unusual* conditions require them. For informative bulletins or catalog, write McAlear Manufacturing Company, 1915 S. Western Avenue, Chicago 8.** ***Affiliated with Hawlon-Waters, Tulsa, Okla.; Climax Engineering Co., Clinton, Iowa.***

the L. G. S. Spring Clutch Corp. of Indianapolis, Ind., a wholly-owned subsidiary of the Curtiss-Wright Corp. Mr. Gleeson has been with the corporation since 1936.

William R. Hill has been appointed general sales manager of industrial and commercial sales of the Warren Steam Pump Co., Inc., Warren, Mass.

Tube Turns of Louisville, Ky., announces the appointment of Arthur R. C. Markl to the post of chief research engineer. R. E. Fritsch, vice-president of Tube Turns since 1929 has been elected president to succeed Walter H. Girdler, Sr., who died on January 7.

Alexander J. Tigges has been appointed district technical advisor of the Air Preheater Corp., with offices in New York. Mr. Tigges was with Jackson & Moreland, Boston firm of consulting engineers for twenty years, but has most recently served as manager of consulting engineering for the Baldwin Locomotive Works, Chester, Pa.

Honan-Crane Corp. subsidiary of the Houdaille-Hershey Corp., has announced the appointment of B. F. Hunter as consulting engineer in charge of research and sales engineering. Mr. Hunter for the past 19 years has been chief lubrication engineer for the Gulf Oil Corp. and the Gulf Refining Co.

Northern Equipment Co., Erie, Pa., has appointed W. L. Hunter as chief engineer. He will supervise engineering, design and research. Mr. Hunter has been associated with the company for the past 18 years in the development of feedwater control, desuperheating, and pressure reduction. He will be assisted by H. A. Schlieder as assistant chief engineer. H. H. Weining has been appointed director of research.

Fisher Governor Co., Marshalltown, Iowa, has announced the appointment of Allan K. Cook, as exclusive sales and engineering representative in western Kentucky and southern Indiana, with offices at 505 S. Third Street, Louisville, Kentucky.

Cleaver - Brooks Co., Milwaukee, Wis., has announced the appointment of Frederick W. Hainer as vice-president.

Howard A. Sommers has been made chief engineer of The Mathieson Alkali Works with headquarters in New York City. He has been with the organization since 1925 and contributed many ideas for the improvement of high pressure valves and compressor packings and other equipment used in the liquid air and synthetic ammonia industries; the design and construction of magnesium and dry ice plants.

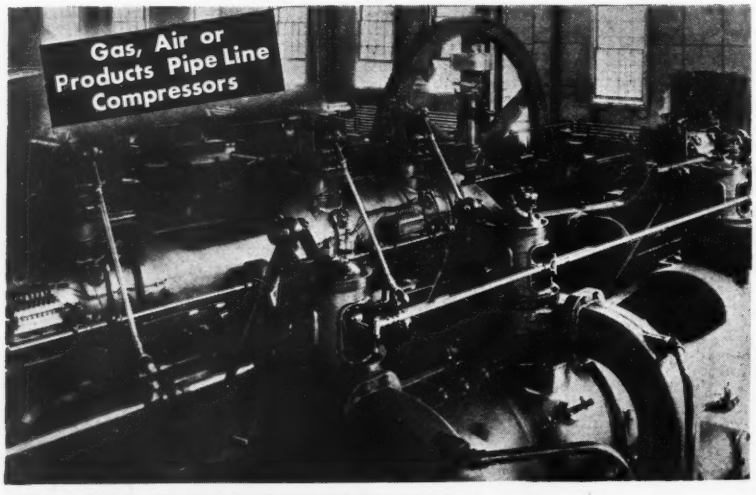
A. C. Mohr has been appointed Chicago District manager of The Union Chain and Mfg. Co., Sandusky, Ohio, with offices at 53 West Jackson Blvd., Chicago 4, Ill.

Philip D. Reed, recently chief of the American Mission for Economic Affairs in London, has been re-elected a director and chairman of the Board of the General Electric Co., a position from which he resigned in January of 1943. In addition he was elected chairman of the board of International General Electric.

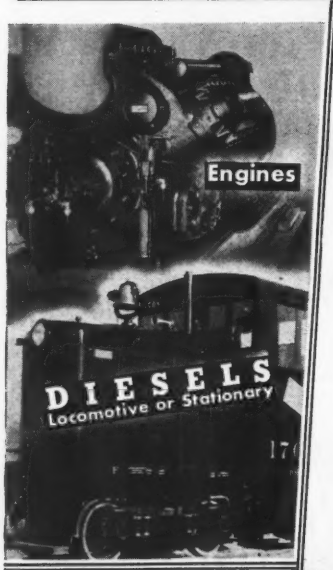
Allis-Chalmers Mfg. Co., Milwaukee, Wis., has appointed U. E. Sandelin manager of the Company's Seattle, Washington district office. Sandelin succeeds A. J. Schmitz, who has been named Pacific regional manager.

American Chain & Cable Co., Inc., Bridgeport 2, Conn., has announced the following appointments: Ralph J. Teeple, general district sales manager of the New York District; William Wagner, New York District sales manager for the Reading-Pratt & Cady Division, with headquarters at 230 Park Avenue, New York City; and E. Coit Magens, manager of the Valve Division, American Chain & Cable Company Export Department.

Westinghouse Electric & Mfg. Co. has recently announced the following appointments: W. O. Lippman as assistant to the president in charge of the Headquarters Manufacturing Department; J. R. Weaver, works manager of the East Springfield, Mass., works; George S. Ryan, assistant to Vice-President T. I. Phillips; C. B. Dick, manager of the Feeder Division; E. R. Perry, manager of the Micarta Division; S. C. Hoey, assistant director of the Headquarters Manufacturing Engineering Department; Earl W. McBratney, district sales promotion manager in the North Pacific District; Arthur F. Sheean, district lamp manager in the North Pacific District with headquarters in Seattle; Eric Hall, Jersey Division manager with offices in Newark, N. J.; Thomas I. Lane, assistant to the Central District manager with offices in Pittsburgh, Pa.; E. W. Hoffman, Central District order supervisor; and A. B. McKelvy, staff assistant in the Central District.



WATER PROBLEMS RESPOND TO



HAERING GLUCOSATES

FOR

CORROSION & SCALE CONTROL.

—o—

WRITE FOR

"H-O-H WATER STUDIES"

WE READ WATER

D. W. HAERING & CO., Inc.

GENERAL OFFICES:

205 West Wacker Drive, Chicago 6, Ill.

FLAMENOL Showed No Aging
THIS FLAMENOL CABLE, after six years' exposure to weather, without covering, is as good as new. Note the glossy, uncracked surface.
THIS OIL-BASE, RUBBER-INSULATED cable, exposed to identical conditions over the same period, is dull and badly cracked.
THIS MINERAL-BASE, RUBBER-INSULATED cable, after the same exposure, shows the same dullness and cracking as the oil-base rubber insulation.

IN THIS SIX-YEAR TEST UNDER FLORIDA'S SUN

Back in 1937, a large railroad company operating in the South, where climate is particularly unkind to cable insulations, decided to test the stamina of various types of insulation. Two of the samples tested were the usual rubber-insulated types; the third was Flamenol. None was protected by braid or other covering, so that insulation was exposed directly to sun and weather.

In 1943, after six years of continuous exposure, the three samples were taken down, and examined. The dramatically conclusive results are shown in the photographs above. Only Flamenol had stayed young!

FLAMENOL RESISTS ACID, ALKALI, OIL, AND WATER

Before the war, millions of feet of Flamenol cable had already been installed in factories, oil refineries, mines and railroads; places where its ability to resist most solvents and heat made it a "must." In the future, this proved-performance cable will find even wider fields of application in reducing maintenance costs and minimizing shut-downs due to insulation failure.

Note, at the right, Flamenol's operating, installation, and maintenance advantages. For complete information, ask our local office, or write to *General Electric Company, Schenectady 5, N. Y.*

11 OUTSTANDING ADVANTAGES OF *FLAMENOL*

1. **FLAME RESISTANCE**—*will not support combustion.*
2. **CORROSION RESISTANCE**—*immune to action of oils, acids and alkalis.*
3. **SUPER-AGING**—*will not oxidize, therefore highly resistant to sunlight and weathering.*
4. **EXCELLENT PHYSICAL PROPERTIES**—*minimum tensile strength, 1,500 lb per sq in.; minimum elongation, 100 per cent.*
5. **CONSTANT DIELECTRIC STRENGTH**—*retained at about 720 volts per mil under severe operating conditions.*
6. **SMALL DIAMETER**—*saves space, and speeds wiring.*
7. **SMOOTH SURFACE**—*facilitates pulling through conduit.*
8. **VARIETY OF COLORS**—*simplifies circuit tracing.*
9. **FREE STRIPPING**—*steps up installation, avoids weakening nicks on conductors.*
10. **WIDE RANGE OF CONSTRUCTIONS**—*aids selection for special applications.*
11. **SELF-PROTECTING FINISH**—*eliminates need for braid covering, saves space and weight.*

Buy all the BONDS you can—and keep all you buy

GENERAL ELECTRIC

NEWS *from* THE FIELD

Midwest Power Conference Cancelled for 1945

STANTON E. WINSTON, director of the Midwest Power Conference, has announced that the application of the Conference before the War Committee on Conventions has been denied and the Conference scheduled for April 9 and 10 at the Palmer House has been cancelled.

This would have been the eighth annual meeting of the Conference bringing outstanding men in the power field to Chicago. The Conferences have been sponsored by Illinois Institute of Technology, with other educational institutions and technical societies co-operating.

Mr. Winston also said there would be no publication of the papers planned for this year's Conference. The Conference, however, will be resumed as an April feature as soon as wartime regulations permit.

Midwest Research Institute

FOLLOWING A MEETING of trustees February 5, at which time the extensive research program was outlined, the newly formed Midwest Research Institute, Kansas City, Mo., was launched into full-scale production. The Institute's laboratories, already employed in the study of a number of projects are being equipped and expanded to cover all research activities.

Harold Vagtborg, former director of the Armour Research Foundation, Chicago, is president of the Institute.

Included in the group of 100 trustees are Charles F. Kettering, president of General Motors Research Corp., Detroit; Dr. Ernest W. Reid, vice-president and head of the research department of Corn Products Refining Co., New York; Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh; S. D. Kirkpatrick, editor, Chemical & Metallurgical Engineering, New York; Walter J. Murphy, editor, American Chemical Society Journals, Washington; Wheeler McMillen, president, National Farm Chemurgic Council, Columbus, Ohio, and Hon. Harry S. Truman, vice-president of the United States. Others represent agriculture, commerce, industry and educational interests of the Middle West.

Activities of the Institute will cover chemistry, physics, metallurgy, mineralogy, biology, bacteriology, chemical, civil, electrical and mechanical engineering and other fields of science and science application.

Tubing for Pipe Lines

THE TWO PLANTS of the Babcock & Wilcox Co. at Alliance, Ohio, have started production on their three thousandth mile of welded invasion tubing used to pipe oil and other necessary fuels to the front. The two mills have produced a substantial portion of the country's total output of four-inch (outside-diameter) tubes for invasion pipe lines. A single welding unit in one plant produces between 10 and 12 mi a day of the tubing, and capacity production is between 20 and 25 mi a day.

The pipe is made in lengths of 20 ft, 4-in. in diameter, of 14 gage low carbon steel. Weighing 67 lb, the tubes are light enough for a single man to handle, allowing quick action in the field. Three squads of men can lay between 70 and 80 mi of tubing a day.

The lengths are joined together in the field by means of a standard coupling device and a rubber gasket. The grooved ends of two joints of the tubes are connected and gasketed, then the bolts in the coupling tightened. This operation repeated on 264 lengths completes a mile. These pipe lines have played an important part in the Sicilian, North African, and Normandy invasion campaigns. One petroleum pipe line carries enough fuel to free 250 trucks for other purposes.

Sound Level Meters

THE AMERICAN STANDARDS ASSOCIATION, 70 East 45th St., New York 17, N. Y., has approved a new American Standard for Sound Level Meters used for measuring the intensities of noise and other sounds in order to evaluate their relative effect on the ear. One practical application of this standard is in manufacture of the meters used to check the objectionableness of noises from various sources.

The new standard supersedes a tentative standard originally issued in 1936. This has been brought up to date in accordance with developments in accoustical practice in the sound management field. Work on the new standard was carried out by a committee of technical experts under the direction of the Accoustical Society of America.

What does **CLEANING CURVED TUBES** *mean to you?*

Does it mean jamming of the cleaner when approaching curves—difficulty in negotiating short-radius bends—slowing up of tube cleaning in bends because of insufficient power—difficulty in withdrawing the cleaner after traversing a curve? Many engineers encounter all of these problems.

Wilson, however, has developed a line of tube cleaners for use in curved tubes from 1" O.D. to the largest ever cleaned—tube cleaners that will go a long way toward helping you overcome these and other curved-tube-cleaning troubles.

Thomas C. Wilson's engineering staff is available for consultation on difficult or unusual tube cleaning problems. A 40 page bulletin describing the complete Wilson line—and a copy of the Wilson Tube Cleaner's Check List will be sent on request.

Modern tube-cleaners for the problems of today.

wilson

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

7 ways to use LUMNITE in power plants

Operators and builders of steam power plants reduce outages and maintenance costs by using corrosion-resistant and heat-resistant concretes and mortars made with this special cement.

1. **Ash Pit and Cinder Catcher Linings**—Heat-Resistant LUMNITE concrete withstands wear and corrosion in both wet-type and dry-type units.
2. **Coal Bunker Linings**—LUMNITE concrete resists abrasion and corrosion.
3. **Flue and Duct Linings**—LUMNITE concrete resists abrasion of flue gases and fly ash, provides insulation where required.
4. **For Steel Stacks**—Jointless LUMNITE linings, generally applied with a cement gun, protect steel stacks from corrosion; their insulating properties improve efficiency.
5. **For Brick Chimneys and Linings**—LUMNITE mortar resists attack of sulphur compounds from stack gases; especially good when operating intermittently or at low temperatures.
6. **Castable Refractories, made with LUMNITE**—used for jointless walls and arches, baffles, burner blocks, door linings, stoker settings and general refractory purposes.
7. **Overnight Structural Concrete**—For rapid maintenance, LUMNITE provides full-strength concrete in 24 hours or less, even in freezing weather.

√ √ √

WHAT IS LUMNITE?

LUMNITE is a special hydraulic cement for special purposes. It is of the calcium-aluminate type and is not a portland cement. It is essentially a structural cement used with special aggregates to make concrete having corrosion-resistant and heat-resistant properties, and for rapid-hardening structural concrete.

LUMNITE is packed in multi-wall, moisture-proof paper bags and may be stocked like portland cement. For convenient volume measurement, one cubic foot of LUMNITE is packed in each bag.

LUMNITE AVAILABLE NOW

LUMNITE can now be purchased without restrictions or priorities. It may be obtained from building supply dealers throughout the United States and in Canada.

Send for the names of dealers near you and for detailed information on specific uses of LUMNITE in power plants. Also ask for reprint of article **"Deterioration and Maintenance of Power Plant Structures."**

THE ATLAS LUMNITE CEMENT COMPANY

(United States Steel Corporation Subsidiary)

135 East 42nd Street • New York 17, N.Y.

ONE-MAN OPERATION

. . . saves time and labor

No helper is needed with a Roto Tube Cleaner. One man can handle a tube cleaning job by himself with the convenient Roto Operating Air Valve on the motor.

Roto one-man operated tube cleaners will help to eliminate power losses and step up the capacity of your plant by descaling your tubes much faster than with old type cleaners.

Roto Tube Cleaners are available for all sizes and shapes of tubes, for operation with air, steam or water. Send for details.

with ROTO TUBE CLEANERS

Roto Model 135 air-driven motor with swing-frame head and air valve for one-man operation.

The ROTO Company
145 Sussex Ave.,
Newark, N. J.

A Division of Elliott Company

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

Among the improvements over the tentative standard are the inclusion of design objective and tolerance curves for flat response-frequency characteristics of sound level meters and slight revisions in the previously agreed-on curves for 40 and 70 decibel equal loudness contours. These last are used to weight meter readings to correspond more closely with the actual effect of noise upon the ear at different levels of sound loudness. To facilitate calculations by sound engineers in making measurements on special types of noises, the data from which the design objective response curves of sound level meters have been plotted are also given in the new standard.

Officers for IUHA

AT THE NINETEENTH ANNUAL MEETING of the Industrial Unit Heater Association held at Boston, Mass., on January 25, 1945, the following officers were elected for the ensuing year: F. P. Kohlbry, president; N. Downey, vice-president; and L. O. Monroe, secretary-treasurer.

Mr. Kohlbry is president of the Airtherm Mfg. Co., St. Louis, Mo., and Mr. Downey is manager of the Unit Heater Division of The Trane Co., LaCrosse, Wis.

Midwest Stoker Association Officers

MIDWEST STOKER ASSOCIATION, at its annual meeting held in Chicago on February 7, re-elected all incumbent officers and members of the board of directors for another term expiring January 1, 1946. The officers are:

John J. Hayes, president, of the Auburn Stoker Co.; William J. O'Neil, vice-president, of the Iron Fireman Mfg. Co.; and Joseph G. Beard, secretary-treasurer, of the Illinois Iron and Bolt Co. Members of the board of directors re-elected were as follows: Messrs. Hayes, O'Neil and Beard; F. H. Herndon of the Link-Belt Co.; and F. J. Moran of C. E. Sundberg Co. President Hayes re-appointed the following as chairmen of the organization's standing committees: Labor Relation—E. W. Jones of the Iron Fireman Mfg. Co.; Engineering—E. M. May of the Steel Products Engineering Co.; and Membership—W. J. O'Neil.

Power Plants on Skids

THE FIRST SLED-BORNE Diesel power plants designed to supply emergency current used by U. S. Army Engineers in meeting military and civilian needs in occupied countries are being completed by the Graham-Paige Motors subsidiary at Warren, Ohio.

Generating units of 246 to 640 hp are being mounted on welded steel platforms, or skids. The skids permit immediate operation of the power plants upon arrival, without using prepared bases at their destinations.

The company is also converting the generating sets, originally intended for shipboard use, from salt-water to fresh-water cooling by addition of radiators and fans, and changing them from 60-cycle to 50-cycle output to conform with most continental power systems.

Transported on trailers of the tank-recovery type, the complete units weighing up to 33½ tons can be quickly hauled into position by tractors working in tandem. They will

BRIGGS FU[illegible]S EA[illegible] OIL CLARIFIERS

Save Over $1300.00 per Month for

MAGGIO ICE CO., BOSTON, MASS.

After six months of 24 hours a day operation, oil analysis shows oil is still in excellent condition

↑ Maggio Ice Co. plant. Capacity 210 tons of ice per 24 hr. day.

← DF-2-50-A Briggs Fuel Oil Clarifier. A unique installation whereby fuel oil is filtered from tank truck to storage tank and filtered again when pumped to engine.

↑ Engine room of Maggio Ice Co., showing two 170 HP and three 125 HP Cummins Diesels—all Briggs equipped.

← Close up of one of the D-3-AR-V5 Lube Oil Clarifiers installed by-pass off pressure line with cutoffs to eliminate engine stoppage while changing refills.

Figures tell an interesting story!

Previous to installing Briggs Clarifiers, it was necessary to change oil and completely clean lube system monthly. In dollars and cents—this cost Maggio Ice Company 1/5 of entire plant's 210 ton per day capacity for about 1½ days per month per engine or 7½ days. With ice selling at 30¢ per hundred pounds, the company lost $1,260.00 in sales. Each oil change cost, in oil, $45.00.

Briggs changed the picture. Oil has not been changed in six months. Briggs refill cartridges are changed without stopping engines. Fuel oil consumption averages 1,000 gallons per day. Refills in the Fuel Oil Clarifier have not been changed since installation.

Briggs Oil Clarifiers can make your operation more profitable. Get the facts about Briggs method of oil filtration from the Briggs representative nearest you. Look in the classified section of your phone book under "Filters" . . . or write manufacturer for information.

Briggs

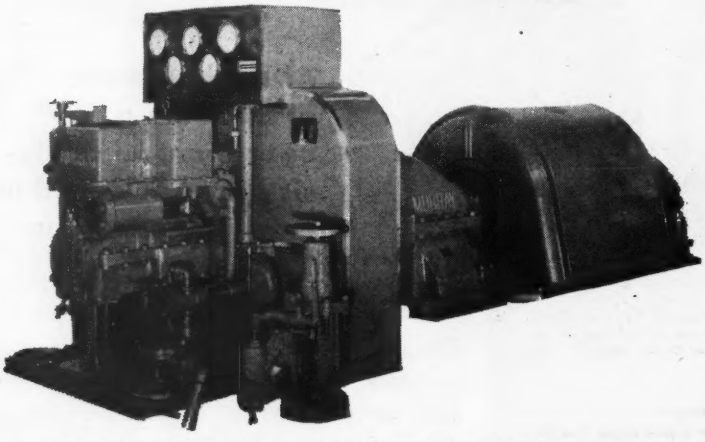
PIONEERS IN MODERN OIL FILTRATION

BRIGGS CLARIFIER COMPANY

GENERAL OFFICES, WASHINGTON 7, D. C.

Distributors in Principal Cities

FOR POWER
MURRAY
TURBINE GENERATORS



Do you need additional POWER? Are you losing POWER by allowing steam to go through reducing valves to process? Have your plant changes thrown your plant heat balance off from the way it should operate?

Correct the situation with a MURRAY STEAM TURBINE GENERATOR SET, properly designed for your present operating conditions. Whether your plant needs a straight non-condensing unit, or one designed for bleeder or mixed pressure operation, MURRAY has already built a similar machine, now in satisfactory operation for a number of years, among the numerous machines furnished industrial and municipal plants.

There is a MURRAY sales representative near you, ready to serve you, with information or guidance in planning.

MURRAY also produces:

Multistage and single stage Mechanical Drive Turbines
Vertical single stage turbines
High Speed Reduction Gears
Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

Cuts your gasket costs in half

The most remarkable tool ever invented.

Write for Booklet

THE ALLPAX GASKET CUTTER
Manufactured by
THE ALLPAX COMPANY, INC.
Distributors everywhere *Mamaroneck, N. Y.*

serve as emergency "stop-gaps," cutting in on existing power lines to produce current for water supply, sewage disposal and a small amount of illumination until regular facilities can be restored.

New ENGINEERING BOOKS

Coal Preparation. Edited by David R. Mitchell, assisted by an Editorial Advisory Board. Copyright, 1943, First Edition, 6¼ by 9¼-in., 729 pages, simulated leather stiff binding. Published by The American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York 18, N. Y. Price $6.00.

This is one of the most comprehensive and up-to-date works on the subject of coal preparation that is available in present-day literature, and the book is highly recommended to any engineer who wishes to familiarize himself with present-day practice in coal preparation or needs a reference book to which he can turn for specific information on coal preparation problems.

The committee responsible for the preparation of this book had in mind that it should be as nearly up-to-date as possible and that it would appeal to the operating men while at the same time adequately show the theory back of many processes used. A perusal of the book would indicate that the editor has admirably accomplished the purpose intended.

The book is divided into 23 chapters, each written by specialists and the subjects covered include economics of coal preparation, characteristics of coal and its associated impurities, sampling, use specifications, screening, breaking and crushing, preparation at the face, hand picking, gravity concentration, classifier type washers, launder washers, jigs, concentrating tables, dense media cleaning, pneumatic cleaning, froth flotation, water treatment, drying, dedusting, treatment of coal surfaces, plant operation and loading.

Conveyors and Related Equipment. By Wilbur G. Hudson. Copyright 1944; 6½ by 8½ in.; 341 pages; cloth cover; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y. Price $5.00.

This is the only up to date book we know of, in fact the only book we know of, on the subject of conveyors and their related equipment. It is based on a lifetime of experience in the field of materials handling acquired by the author as member of one of the country's leading manufacturers of materials handling equipment. He has endeavored in this book to present information useful to both student engineers and plant engineers, architects and consultants, and, as he rightly points out, it is necessary to compromise in doing this. He has assumed, therefore, that the reader, through study of catalogs and other data furnished by the manufacturers of the equipment, will be familiar with the general types and in a general way with their application. One of his principal aims is to make the book useful to those who want data on the

Where the need is

More Speed

..transmit power through a Philadelphia

TYPE HI HIGH SPEED UNIT

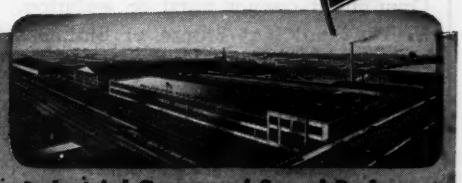
For applications where shaft speeds and pitch line velocities exceed the limits for standard commercial parallel shaft gear units, the Philadelphia Type HI High Speed Unit has performed with great satisfaction. These drives are equipped with special force feed lubrication of gears and a water cooled heat exchanger to dissipate the heat generated in high speed operation. Special bearings keep the gears running true. Noise and vibration are kept to a minimum through the balancing of the gears combined with rigid bearing mounting. The gears, hobbed on special machines are double helical to balance the thrust reaction.

The Type HI units are ideal for turbine drive to pumps or other machinery or for speed increasers from low speed motors or engines to high speed pumps or fans.

Illustrated above is a typical drive which transmits 1800 H. P. continuously from a 685 R. P. M. water wheel to a 1200 R. P. M. generator.

We will gladly give you further information about Philadelphia High Speed Units . . . tell us your problem.

ARMY E NAVY



Philadelphia

GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK • PITTSBURGH • CHICAGO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

HONAN-CRANE
Oil Purification Engineers

. . . have the advantage of outstanding research and engineering facilities.

Honan-Crane maintains a complete research laboratory at Lebanon, Indiana, and employs the services of national research institutes. Constant research is devoted to the important problem of acidity control, sludging tendencies, corrosion, detergent oils and many other lubrication problems. Honan-Crane Engineers are equipped with the results of this importnt work.

These men also have the counsel and advice of outstanding authorities in the field of oil purification. Paul Honan, with more than 25 years of experience in engineering and building oil purification equipment; A. S. Harlan, chief engineer, and Ben Hunter, lately of Gulf Oil Corporation, one of the world's foremost authorities on lubrication of modern engines and machines.

On problems of oil purification Honan-Crane engineers can give you intelligent advice. Write today. A Honan-Crane Engineer will call at your convenience.

HONAN-CRANE CORPORATION
Subsidiary of Houdaille-Hershey Corporation
201 INDIANAPOLIS AVE. LEBANON, IND.

Honan-Crane has had more than 20 years of experience in engineering and building oil purification equipment.

TEMPLETON RETURN STEAM TRAPS
for Pumping, Boiler Feeding, Draining, Heating and Vacuum Lines

Pumps Water at any temperature or pressure.

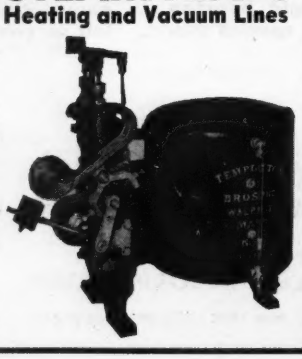
Open float cannot burst or waterlog.

Valves and Seat Bronze or Stainless Steel.

Sizes 1 in. to 4 in. inlet and outlet.

Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.

Ask for catalogue and prices



TEMPLETON BROS., INC.
699 Main St. Walpole, Mass.

kind of equipment to use to best advantage, and those who must have a general knowledge in order to weigh intelligently the recommendations of the manufacturer.

Introductory comments cover the handling of tricky materials such as carbon pellets, sulphur and cement, also, on plant layout and conveyor layout, and general engineering and economic factors, together with characteristics of materials in relation to their behavior on conveyors, the author then devotes a chapter to each of the following: Screw Conveyors; Flight and Apron Conveyors; The Bucket Elevator; The Skip Hoist; The Pivoted Bucket Carrier; Overhead Trams and Conveyors; Conveying En Masse; Pneumatic and Hydraulic Conveyors; The Belt Conveyor; Aerial Tramways; Storage and Transport; Bins and Bunkers; Unloading Water-Borne Cargoes; Crushers, Hammermills, and Pulverizers; Screens and Feeders; Car Unloading; Weighing; Chain Drives, Drive Groups, Motors. The final chapter of particular interest to power engineers deals with Boiler-Plant Coal-Handling Equipment.—C. R. E.

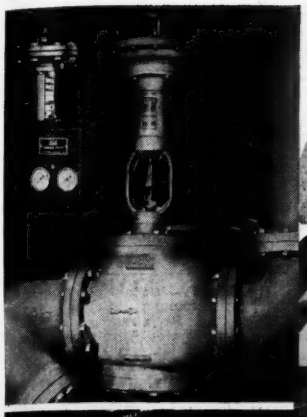
20th Century Engineering. By C. H. S. Tupholme. Copyright, 1944, 6 by 9-in., 201 pages, stiff cloth binding. Published by the Philosophical Library, 15 East 40th Street, New York, N. Y. Price $3.00.

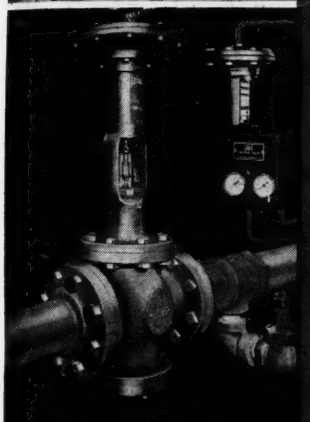
The author of this book, who has written many articles published in POWER PLANT ENGINEERING over a long period of time, writes with knowledge and with a real gift for popularizing a subject. His home being in England, his work as an author has been greatly interfered with by war conditions. He states that the aim of this book is to endeavor to record, primarily for the benefit of laymen, some of the more spectacular engineering progress of the past few years, both during and immediately before the war. No elaborate theories are discussed and only those engineering developments which have proved commercially successful are dealt with in this book.

The reader is presented with sketches of what is going on in engineering evidently with the hope that he will be encouraged to investigate further into specialized engineering works. It is also the author's hope that young men whose interest in engineering has been interrupted by their services to their country, will find the material presented in this book will assist them in getting back into engineering training with definite objectives in mind.

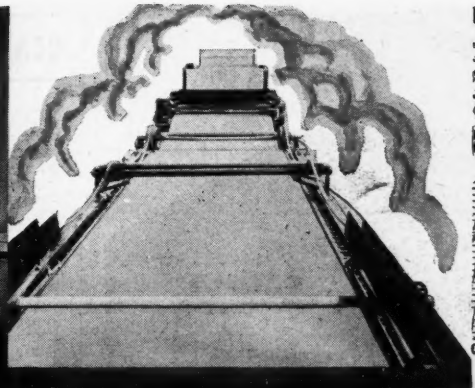
The following list of chapter headings will give an idea as to the scope of the book: Mechanical Power; Engineering Workshop Processes; Air-Conditioning and Refrigeration; Chemical and Metallurgical Engineering; Electrical Engineering; Traction; Marine Engineering; Aircraft; and Physics.

The book is non-technical in that its reading does not require a knowledge of higher mathematics, nor familiarity with technical terms beyond those familiar to the average high school graduate. The book will be found to be interesting reading for those who wish to be brought up to date regarding the recent advancements in engineering fields.



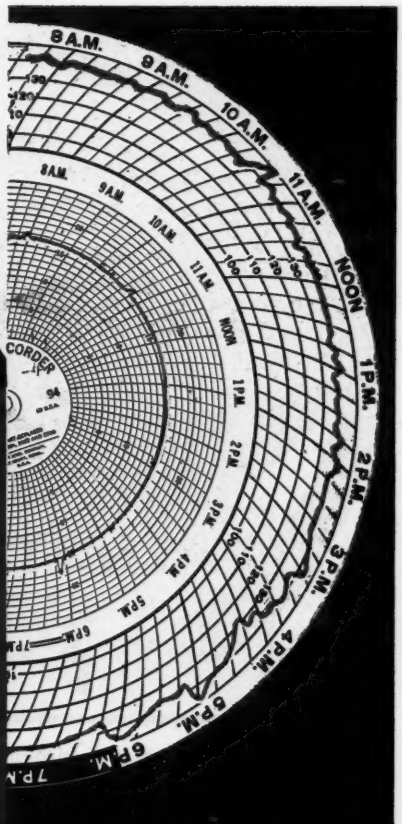


Connected in series, these Leslie Pressure Controllers regulate process steam with laboratory precision—necessary to maintain constant steam pressure to Fourdrinier machine (above center) and regulate paper finish and thickness.



LESLIE CONTROLLERS ARE IN AT THE FINISH

ON HAMERSLEY PAPERS

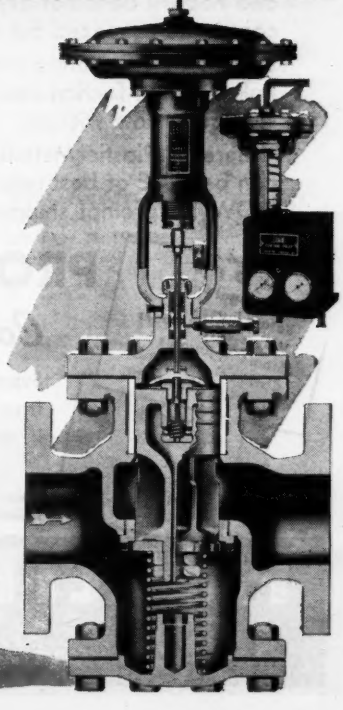


NOTE "LIVE" LINE ONLY ¼ LB. WIDE on low pressure chart and compare it with the wide fluctuations shown on the inlet steam chart. That's CONTROL!

CLOSE REGULATION OF STEAM PRESSURE to the drying rolls is essential in maintaining the micro-fine finish of Glassine and Greaseproof papers at Hamersley Manufacturing Company. For the past five years, this task has been made easier by the use of Leslie Pressure Controllers. They have constantly held the steam pressure at the required 16 p.s.i. within ¼ lb. variations in spite of 20 lb. fluctuations in the nominal 140 p.s.i. inlet.

IN YOUR PLANT, TOO, extreme pressure reductions and overflow control with close throttling on dead end and even action over the entire range may be required. That is where Leslie Pressure Controllers excel. Or you may need the fast valve action of the Leslie Pressure Reducing Valves, Pump Governors and Temperature Controllers with their internal pilot, piston-actuated valves.

CLOSE REGULATION, AND LOW MAINTENANCE are Leslie characteristics because Leslie Controllers incorporate such refinements as non-continuous leakage of auxiliary medium, friction-free stem design of Control Pilot for quick responsive action with small pressure changes, stainless steel seats and discs, and single seated, fully balanced inner valve construction for diaphragm regulating valves. To learn how Leslie Controllers can maintain quality in your plant, write for Bulletin 402.

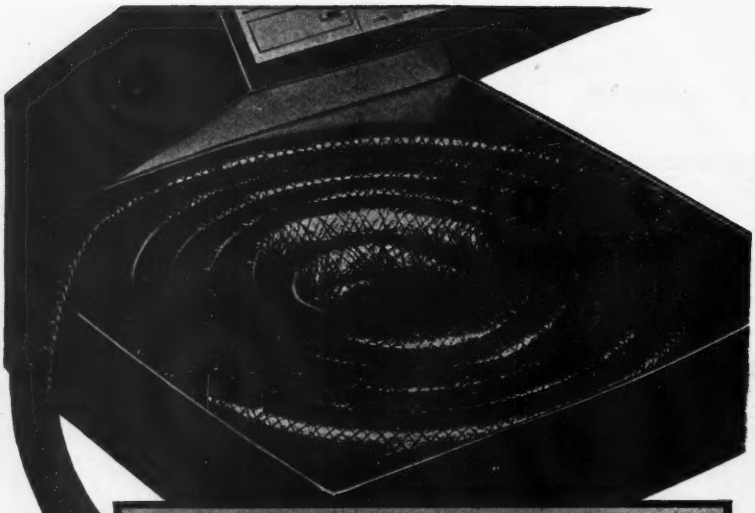


ESTABLISHED 1900

LESLIE

REGULATING VALVES
LESLIE-TYFON WHISTLES

LESLIE CO., LYNDHURST, N. J.



PALMETTO *Plastic* PACKING

- **Exceptional anti-friction properties . . . becomes a smooth, bearing-like sleeve in service.**
- **Completely malleable—may be hammered or rolled to fit any size stuffing box.**
- **Longest-fibre asbestos for extra strength and longer life.**
- **Wide usefulness . . . a general purpose packing for industrial, mining, railroad, marine services.**

This Palmetto Packing has ultra-high resistance to friction and heat. It does not dry out or harden—no liquid lubricant to be squeezed out or melted.

Derives its lubricating properties from *graphite* and soft flakes of anti-friction *bearing metal,* which form a wearing surface of low friction.

Wherever Plastic Metallic Packings are to be used, you can be SURE of best results with PALMETTO . . . available NOW for prompt shipment.

USED FOR
Centrifugal Pumps
Rotary Pumps
Valves of All Types
Steam Apparatus
Chemical Apparatus
Chemical Equipment

PACKS
Steam
Air
Water
Gases
Mild Chemicals

PROMPT DELIVERIES

Coil Form Now Ready

Supplied in square shape, coil form. Order from your local Greene, Tweed distributor, or, if necessary, direct from us.

GREENE, TWEED & CO.
Bronx Boulevard at 238th Street, New York 66, N. Y.
Plants at New York, N. Y., and North Wales, Pennsylvania

PALMETTO *Self-Lubricating* **PACKINGS**

for steam, water, air. PELRO for oils. CUTNO for alkalis. SUPERCUTNO (blue asbestos) for acids. KLERO for foods.

CLASSIFIED ADVERTISING

HELP WANTED

WANTED—In modern large meat packing plant one architectural engineer, one mechanical engineer for general designing, and one mechanical engineer to be assistant power plant engineer. Three years' minimum experience. Address Box 1467, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

POSITION VACANT—Watch Engineer for outstanding municipally owned electric generating plant. Required preparation: High School graduate supplemented by study along mechanical engineering lines—preferably with at least one or two years' college work and at least five years' experience in a power plant. Must be free of draft. In reply, please state age, education, experience, draft status and general qualifications. Address Box 1470, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

WANTED—Powerhouse engineer. High pressure plant, 12,000 KW load, attached to large chemical manufacturing plant in Ohio. Must be technically competent and know how to handle substantial organization. Give full details in first letter. Address Box 1471, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

MECHANICAL draftsmen and engineers experienced in steam power plant design and detailing work. State age, experience and salary desired. WMC rules apply. Write Box 1472, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

WANTED — MECHANICAL ENGINEERING graduate for permanent position in results department of a large steam generating station. Station is operated by a public utility corporation located in the East. Statement of Availability is required. Write Box 1473, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

SALESMEN AND AGENCIES

AGENTS—We want men to handle a time-tested process Condensate Return System which we sell on Guaranteed quick payout saving basis with liberal compensation. Address Box 1461, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

SALES ENGINEER offers to represent good line power plant equipment on exclusive agency basis. Has thorough experience steam and power generating equipment and accessories. Good sales record and contacts in Metropolitan New York area. Address Box No. 1469, Power Plant Engineering, Graybar Bldg., New York, N. Y.

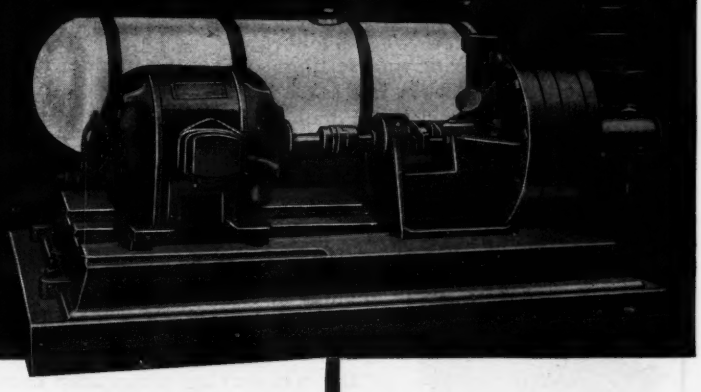
Reminder *for* Advertisers

Please send reservations and copy on or before **10th** of preceding month; complete plates can be accepted up to **17th.** Be an "early bird"—help us mail issues on time. . .

Simplify your process condensate returns with the Stout NO-VENT Boiler Return System

Operates Continuously—

Returns condensate, all of it, fast as formed—at temperature and pressure at which condensed—eliminates steam traps and steam vents—



WHY drop your condensate to atmospheric pressure through steam traps and then lose flash heat to the air through steam vents?.

Hundreds of industrial plants operating cookers, heaters, driers, presses and other steam heated equipment are now saving fuel, water and labor and *greatly increasing their production* as a result of installing the Stout Patented NO-VENT Boiler Return System. The fact that condensate is returned directly to the boiler as fast as formed and under full boiler pressure insures better circulation and drier steam in the steam heated units. Every unit is just as hot as any other unit. Moreover, air, foul gases and non-condensibles are automatically removed.

Fuel savings of 25% are not uncommon, but *Increased Production* is worth many times the saving in fuel. For example, one large manufacturer of Bakelite parts advises of a uniform increase of 10 deg. F in the temperature of his bank of 20 hydraulic presses, with a consequent increase in production and a marked decrease in scrap.

An owner and operator of two large meat-rendering plants reports that prior to the installation of the NO-VENT System they often lost valuable material in cookers due to faulty traps; also that it was necessary to add make-up water to boiler every 45 minutes to one hour. Since using NO-VENT, loss of material has been eliminated entirely and water is only added every 8 hours. He reports a fuel saving of 25%.

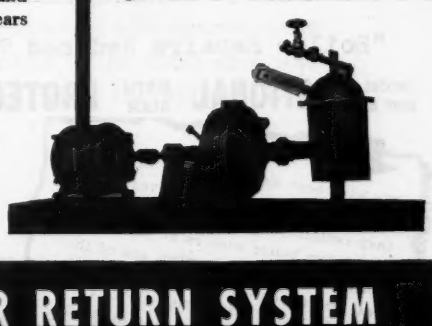
Then, too, the NO-VENT System takes a minimum of maintenance. Many NO-VENTS have been running 5 and 6 years without expense other than electricity, lubrication and packing. Some of the earliest machines are still operating with their original impellers and wearing rings after more than 12 years of service.

NOTE THESE PERFORMANCE FEATURES

ABOVE: The NO-VENT boiler return system, illustrated, is designed to handle 210 bhp at 175 lb. pressure. It consists of a 3 stage NO-VENT Pump developing 150 ft. dynamic head at shut-off. Extra large insulated receiver is equipped with thermometer, automatic air and foul gas remover and internal strainer. Pump, receiver and 3 hp electric motor are all mounted on a cast iron base. This outfit will collect steam condensed at 377 deg. F and return it direct to the boiler without the use of steam traps, vents, or reheating in the entire circuit.

★

BELOW: This simple NO-VENT outfit collects 5610 lbs. of condensate per hour at 150 lb. pressure and returns it direct to the boiler at 366 deg. F.



Get the Facts: **New bulletin shows hookup of Stout NO-VENT Boiler Return System, gives operating details and practical guarantee chart on saving in boiler load. Made in capacities 100 to 800 bhp, pressures to 200 lb. Write for your copy of bulletin.**

Note to Distributors:

Attractive selling franchises now being offered. Your NO-VENT territory may be open. Write or wire today for full details.

Stout

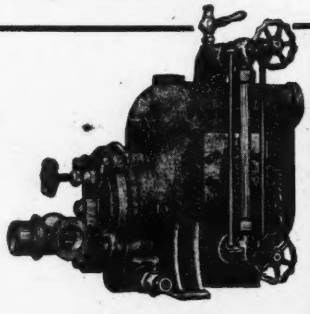
NO-VENT BOILER RETURN SYSTEM

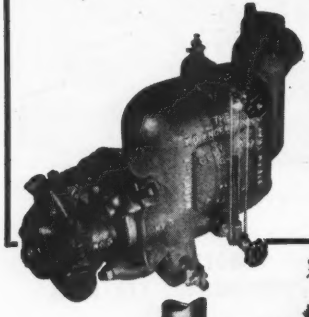
DAVID STOUT & SONS • 6 N. MICHIGAN AVE., CHICAGO 2, ILL.

Through 3 WARS *with* ANDERSON STEAM TRAPS

1898-1902

Back in 1898, when the Spanish-American War and the Philippine Insurrection were taking place, The V. D. Anderson Co. was manufacturing and selling the Model "N" Steam Trap as the most dependable means of draining condensate from steam lines.





1917-1918

When the boys sailed for Europe in 1917, to fight in World War I, an improved Float Trap, Model "D," was serving steam trap users.

1941-194X

As we enter the fourth year of this war Anderson Super-Silvertop Inverted Bucket Steam Traps are draining condensate in thousands of industrial concerns making war supplies.

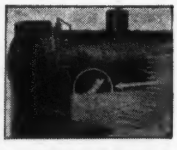
Today's Super-Silvertop Steam Traps provide steam trap users with the most efficient and economical means of draining condensate.

THE V. D. ANDERSON CO.
1939 WEST 96th ST. • CLEVELAND 2, OHIO

SUPER-SILVERTOP STEAM TRAPS

"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**



We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

XZIT
Cleans from fire-box to top of stack

Removes fire-scale and soot while boilers operate

Why tolerate fire-scale, soot, sparking and stack fires, when these are so easily and quickly eliminated with Xzit?

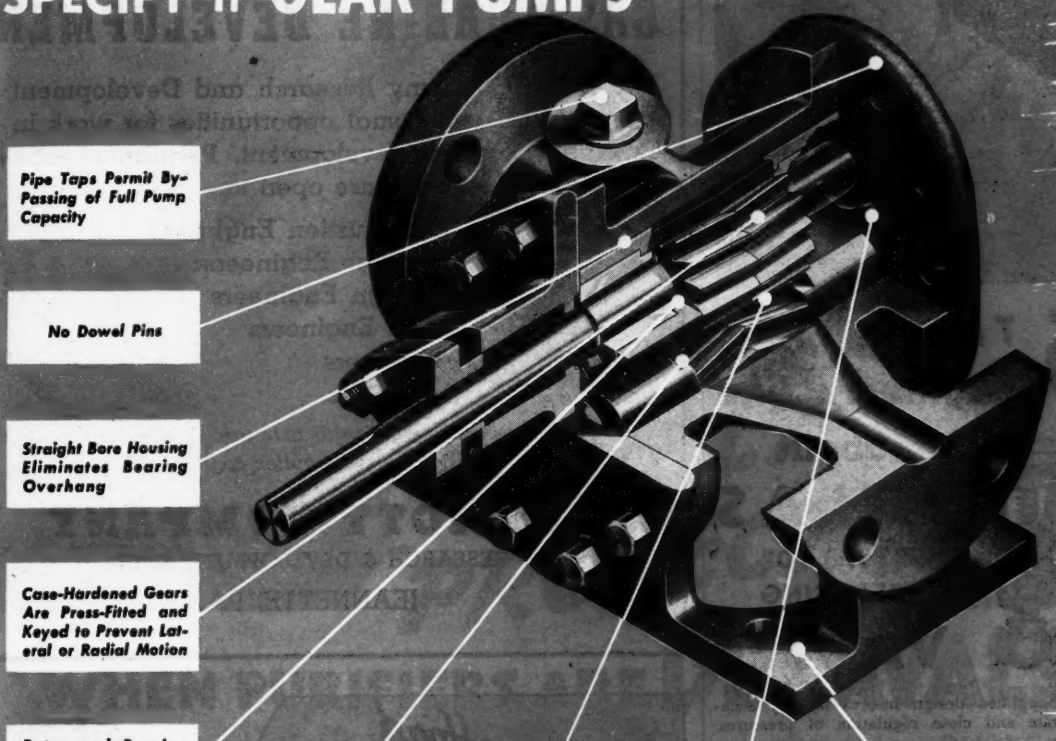
Fed into the fire-box while the boiler remains in operation, Xzit chemically removes soot and loosens fire-scale so it drops off.

By keeping heating surfaces clean from fire-box to top of stack, Xzit gives you increased fuel efficiency, reduces blowings, and keeps equipment on the line longer. Xzit eliminates sparking and puts out stack fires instantly.

Our service engineer will gladly demonstrate Xzit in your plant. Write.

XZIT SALES CO.
1031 Clinton St., Hoboken, N. J.

FOR *Tough* PUMPING OPERATIONS SPECIFY SK GEAR PUMPS


Pipe Taps Permit By-Passing of Full Pump Capacity
No Dowel Pins
Straight Bore Housing Eliminates Bearing Overhang
Case-Hardened Gears Are Press-Fitted and Keyed to Prevent Lateral or Radial Motion
Rotor and Bearing Assembly Removable as a Unit
Relief Pockets Eliminate Liquid Trapping
Special High Pressure Tooth Angle Prevents Excessive Slippage
Pressure on Stuffing Box is Dissipated Through Channel in Cover Plates
Integrated Casting Provides Rigid Housing

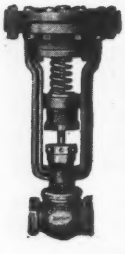
Experience has proven smooth performance, high efficiency, low maintenance and long life of SK Gear Pumps in handling capacities up to 1000 gpm and pressure up to 3500 psi. For detailed information, write for Bulletin 17A.

SCHUTTE & KOERTING CO. *Manufacturing Engineers*

1156 THOMPSON STREET, PHILADELPHIA 22, PA.

JET APPARATUS • CONDENSERS AND VACUUM PUMPS • HEAT TRANSFER EQUIPMENT • VALVES • ROTAMETERS AND FLOW INDICATORS • GEAR PUMPS • STRAINERS • OIL BURNING EQUIPMENT • SPRAY NOZZLES AND ATOMIZERS • RADIAFIN TUBES

5 Things most Engineers like about ATLAS TYPE "D" REDUCING VALVES



1—Simplified design insures notably accurate and close regulation of pressures.

2—Easy to inspect. Equipped with single seat renewable discs of composition or metal; stainless steel valve stem; and removable diaphragm top.

3—Adapted for pressures up to 175 lb.—Steam, Air, or Gas.

4—Durable bronze bodies, screwed ends.

5—Available with double port balanced seats.

For nearly a half century ATLAS has specialized in regulating valves for every service. What are your regulating problems? We shall be glad to send you useful data on this or other ATLAS products. Use the coupon below.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

291 South St.
Newark 5, New Jersey
Representatives in Principal Cities

☐ Without obligation, please send the "ATLAS Reducing Valve Data and Price Book." Also, please send complete information on the following ATLAS products:

☐ Damper Regulators	☐ Float Valves
☐ Temperature Regulators	☐ Oil Control Cocks
☐ Exhaust Control Systems	☐ Humidity Controllers
☐ Pressure Regulators	☐ Thermostats
☐ Campbell Boiler Feed Water Regulators	☐ Balanced Valves
☐ Pump Governors	☐ Control Valves

Name .....

Firm .....

Address .....

EXPERIENCED ENGINEERS
FOR
GAS TURBINE DEVELOPMENT

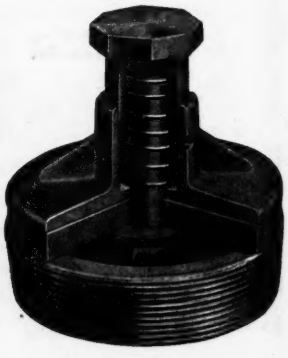
The Elliott Company Research and Development Department offers unusual opportunities for work in this new field of power development. Permanent jobs and several key positions are open to:

Combustion Engineers
Process Engineers
Design Engineers
Test Engineers
Checkers
Detailers

This is war work with a future. Write giving full details. All replies confidential.

ELLIOTT COMPANY
RESEARCH & DEVELOPMENT DEPT.
JEANNETTE, PA.

Can you afford to run racing **STEAM-WASTING PUMPS?**



S-l-o-w 'Em Down With COMBINATION NON-TILT VALVES

If your plant operates two or more reciprocating pumps — Boiler Feed, Vacuum, Condenser, General Service—the chances are that you can save up to 15% in steam and cut maintenance cost at the same time by using COMBINATION Pump Valves. They lift straight, close quickly, prevent racing and hammering, eliminate many pump repair bills. Ask for descriptive bulletin.

They Match the Fine Performance of Combination Silent Check Valves.

COMBINATION PUMP VALVE CO.
846 WIOTA STREET, PHILADELPHIA, PA.

OFFICIAL U. S. NAVY PHOTO

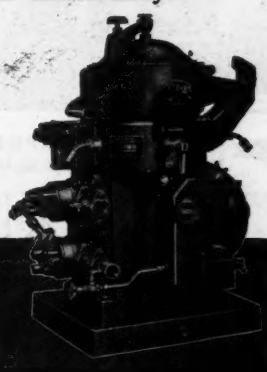
★WHEN PURIFIERS ARE DE LAVALS

ON land or sea, De Laval Oil Purifiers provide maximum protection against *both* principal sources of lubrication failure—*water* and *dirt*. They utilize centrifugal force to instantaneously remove these *two* trouble-makers from the oil and thus constantly maintain its lubricating efficiency. By keeping the oil continuously and unfailingly clean and dry, they enable it to perform with "new oil" efficiency and safety over exceptionally long periods of time.

Whether the power unit is a Diesel engine requiring only a De Laval centrifugal Oil Purifier, or a turbine where use of the De Laval-Funk Process—the ultimate in turbine oil protection—is indicated, there is no more practical, efficient means of guarding it against lubricating oil trouble than by means of a De Laval centrifugal Oil Purifier operating on continuous by-pass. This will insure that the oil is freed of impurities and water three or four times daily.

•*Write for complete information, sent without obligation.*

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER



DE LAVAL OIL PURIFIERS
FOR MORE DEPENDABLE POWER PRODUCTION

Why they Last and last and Last

The Cochrane Multiport Relief Valve is popular not only because of its remarkable service, but because of its long, trouble free life.

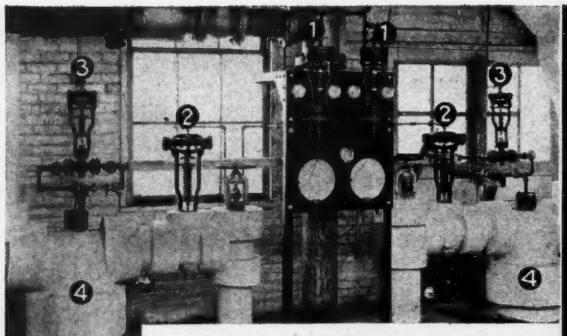
COCHRANE MULTIPORT RELIEF VALVES

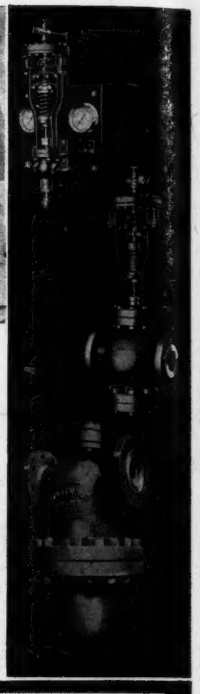
In many plants all over this country Cochrane Multiport Back Pressure Relief Valves have been operating continuously for ten, twenty, twenty-five years—and longer—without replacement of a single part. The care, the skill, the close precision to which this remarkable valve is built, are some of the reasons.

Write for Publication 4150

TESTING MULTIPORT VALVE AT FACTORY

COCHRANE CORPORATION
3123 N. 17th St., Philadelphia 32, Pa.





Swartwout Controls

bring you low-cost dependable reducing and desuperheating

above— 1. *Master Controls.* 2. *Reducing Valves.* 3. *Water Control Valves.* 4. *Desuperheaters—* **All Swartwout**

This exacting service for your modern higher pressure boilers is delivered efficiently and accurately by Swartwout Equipment. Whatever your needs in reducing, desuperheating and pressure control, Swartwout engineers equipment best suited to handle your job with positive uniform results. Write for bulletins.

Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave. Cleveland 12, Ohio

LaMOTTE BOILER FEED WATER TEST UNITS

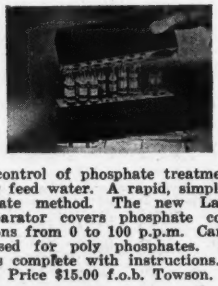
The LaMotte Research Department has developed a reliable series of chemical tests for boiler feed water control of the following constituents:

Phosphates	**Dissolved Oxygen**
Chlorides	**Sulfates**
Total Alkalinity	**Hardness**

pH (Hydrogen-Ion Concentration)

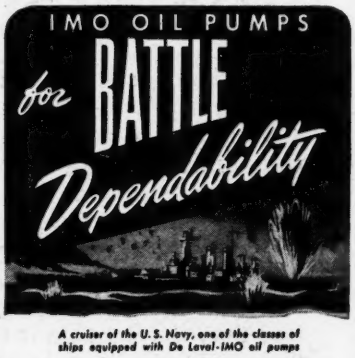
For positive control of efficient water treatment, there is a LaMotte Unit for each constituent (Phosphate Comparator, illustrated and described below). Each unit is simple to operate and inexpensive to install. Write for illustrated booklet describing this equipment.

LaMotte Phosphate Comparator



For control of phosphate treatment of boiler feed water. A rapid, simple and accurate method. The new LaMotte Comparator covers phosphate concentrations from 0 to 100 p.p.m. Can also be used for poly phosphates. Outfit comes complete with instructions.
Price $15.00 f.o.b. Towson.

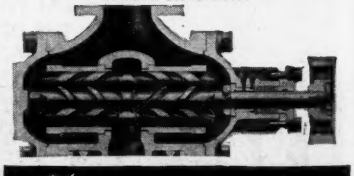
LaMOTTE CHEMICAL PRODUCTS CO.
Dept. P.P.E., Towson 4, Baltimore, Md.



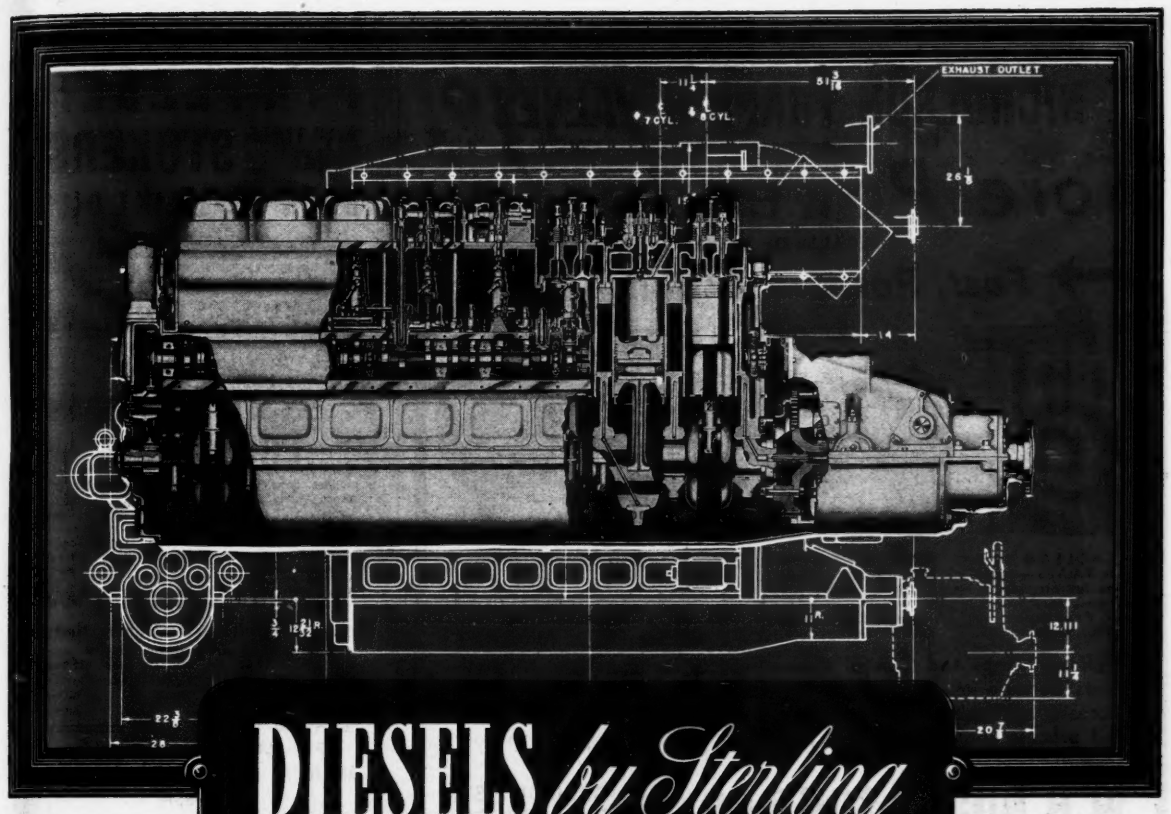
A cruiser of the U. S. Navy, one of the classes of ships equipped with De Laval-IMO oil pumps

On fighting ships, where reliability and dependability under strain are all important and where space is at a premium, many thousand IMO oil pumps are in use pumping fuel oil, circulating lubricating oils, and operating hydraulic machinery. The simplicity of construction and operation that makes the IMO pump so dependable in battle assures the commercial user of long life and trouble-free operation. This unique pump has practically nothing to get out of order; it has only three moving parts, and no pilot gears or valves.

Write for Leaflet I-117.



IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton 2, New Jersey.



DIESELS *by Sterling*

Out of 40 years of fine engine building

PRODUCTION of the new Sterling Viking Diesel engine is so geared now that almost immediate deliveries are available. Write us for full details of this new power plant for marine or industrial use which gives you the compactness of a gasoline engine of the same power rating plus the economy of diesel fuel. Other Sterling engines—six or eight cylinders—gasoline or gas from 85 hp. to 1800 hp.

ORDERS ACCEPTED NOW FOR EARLY DELIVERIES

"KEEP BUYING WAR BONDS"

STERLING

VIKING DIESEL

STERLING ENGINE COMPANY 1272 Niagara St., Buffalo 13, N. Y.

New York City, 900 Chrysler Bldg. • Washington, D. C., 839 Evans Bldg. • Chicago, Illinois, 855 Board of Trade Bldg.

NICHOLSON TRAPS & VALVES

DELIVER

More Power to You

BECAUSE OF THEIR

Fast, Positive Action

NICHOLSON CONTROL VALVES—Many types for air, steam, oil, gas, tar, water, etc. Pressures to 5000 lbs. Catalog 543.

NICHOLSON THERMOSTATIC STEAM TRAPS—5 types; sizes ¼" to 2"; pressures vacuum to 225 lbs. Bulletin 544.

NICHOLSON HEAVY-DUTY TRAPS—Weight-operated, piston-operated, compressed air and gasoline traps for all pressures in power and process applications. Time-tested. Catalog 444.

Nicholson Traps and Control Valves—widely recommended by engineers because of the way they speed steam circulation and thus increase applicable power—are made for practically every power and process application. Send for bulletins listed above, or see our catalog in Sweet's.

W. H. NICHOLSON & CO. 160 OREGON ST. WILKES-BARRE, PA.

FYR-FEEDER

MULTIPLE SPREADER STOKERS

BURN COAL LIKE OIL!

Save with FYR-FEEDER — Burn less coal — Cheaper coal — Local coals — Screenings — Coal Yard Sweepings, wet or dry—WET coal is no handicap.

FYR-FEEDER

Exclusively employs

AIR→ **JET** ←COAL

PROPULSION

Fines burn in suspension, larger pieces are spread evenly over grate.

FYR-FEEDER increases boiler capacity—responds instantly to sudden load variations—requires no special skill or experience to operate—thin fuel bed eliminates clinkers—makes fireman's work much easier—no banking losses.

CHANGE OVER TO FYR-FEEDER NOW

Easily installed in minimum time

FYR-FEEDERS are built in sizes to burn from 300 to 12,000 lbs. coal per hour. If you are or expect to be in the market for automatic coal burning equipment

Wire or Write

FYR-FEEDER Stoker Division

AMERICAN COAL BURNER COMPANY

Engineers

22—19 E. Erie St. Chicago 11, Ill.

VIKING ENGINE ALARM SYSTEMS

GUARD AGAINST ENGINE BREAKDOWN

from:

1. EXCESSIVE TEMPERATURE OF CIRCULATING-WATER SYSTEM
2. INSUFFICIENT PRESSURE IN LUBRICATING-OIL SYSTEM

WRITE FOR DATA SHEETS M-3 and M-3B

Every diesel and gas engine should be properly protected with a Viking alarm system. Viking is a *complete system*, no extras to buy. When water temperature becomes too high or oil-pressure too low, howler sounds to warn operator of danger. Type M-3B provides visual indication of source of trouble, also Heavy-duty construction, factory-set for your own requirements.

VIKING INSTRUMENTS, INC.

403 Fairfield Ave. Stamford, Conn.

THE ASSOCIATED BUSINESS PAPERS — ABP — MEMBER

What This Symbol Means to You

Banded together in The Associated Business Papers is a group of 133 dominant business publications which are independently operated, editorially unfettered, ethically administered. Power Plant Engineering is proud of its membership in ABP, and of the high publishing standards which help to make it an accepted authority in the field of power generation, transmission and utilization.

CRYSTOLON Brick For Heavy Duty

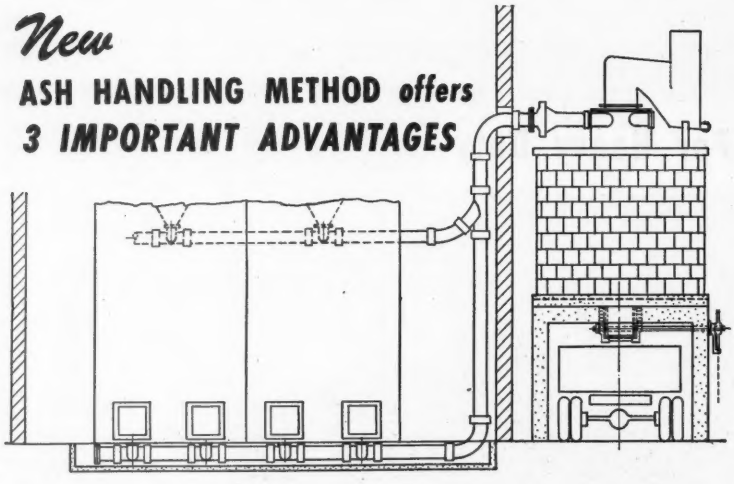
High refractoriness, chemical stability and resistance to abrasion and to slag penetration make CRYSTOLON (SiC) Brick ideal for heavy duty work in stoker-fired furnaces, generators of water gas sets and combustion chambers of high temperature furnaces. The dense surface of CRYSTOLON Brick resists slag penetration so that clinkers are easily removed leaving the brick clean and undamaged.

NORTON COMPANY, Worcester 6, Mass.

Norton Longer Lasting Refractories

New

ASH HANDLING METHOD *offers* 3 IMPORTANT ADVANTAGES



In the Beaumont "Vac-Veyor" pneumatic ash handling system the exhauster, receiver, separator and air washer are combined as one unit. Operating advantages include: (1) All ash delivered into the silo, none into the air. (2) Ashes delivered practically dry, which minimizes the possibility of packing or freezing in the silo. (3) Continuous operation, with low steam consumption. What are your ash handling problems? Send today for literature.

BEAUMONT BIRCH COMPANY
1503 RACE STREET PHILADELPHIA, PA.

DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

TORNADO

PORTABLE INDUSTRIAL VACUUM CLEANER

reduces **DUST DANGER**

QUICKLY cleans walls, floors, line shafting, pipes, overhead beams, etc. Reduces health and fire hazards. Improves working conditions and morale. Cuts waste. Salvages valuable scrap. Increases efficiency.

A real one-man unit. Weighs only 40 lbs. 1 H.P. universal motor, 49" waterlift, 175 c.f.m. Removes dust, chips, lint, etc. Does a thorough cleaning job. Attachments for cleaning everything.

Convertible into Blower for blowing dust and dirt out of motors, generators and hard-to-reach places. Adaptable for spraying paint and insecticide.

FREE TRIAL—WRITE TO
BREUER ELECTRIC MFG. CO.
5108 N. Ravenswood Av., Chicago 40

TAKE THE DUST OUT OF DUSTRY
TORNADO

WHEN YOU NEED HEAT TRANSFER EQUIPMENT

Call on Rempe

Illustration shows final inspection on part of a large shipment of seamless steel coils, manufactured by REMPE for a large chemical plant. Coils were all 2" Grade A-106 tubing tested for 8000 lbs. hydrostatic pressure.

Designers and Builders of
Heat Exchangers
Feed Water Heaters
Coils for Refrigeration and Chemical Processes

When you need Coils, Pipe Bends, Shell and Coil Assemblies, Welded Pipe Assemblies, Supply Headers, and other units that require precision bending and welding—call on Rempe.

Rempe Co. work to your specifications, design and manufacture equipment to do your job most efficiently. REMPE precision manufacture assures you of greater efficiency, better and longer performance.

SEND YOUR SPECIFICATIONS TO US TODAY

REMPE COMPANY
344 No. Sacramento Blvd., Chicago 12, Ill.

AMERICAN CHIMNEY CORPORATION

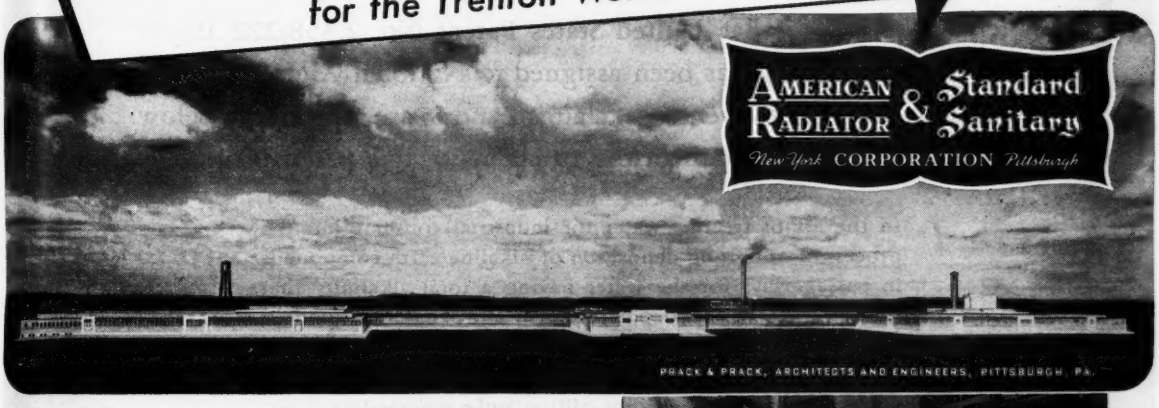
Consult us for:

Radial Brick Chimneys
Common Brick Chimneys
Ornamental Chimneys
Linings for Steel Stacks
Chimney Repairs and Extensions
Installing, Repairing Lightning Rods

AMERICAN CHIMNEY CORPORATION
147 Fourth Ave., New York 3, N. Y.
BRANCHES: BOSTON, MASS.
PHILADELPHIA CLEVELAND DETROIT

POWER by SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

for the Trenton Works of


AMERICAN RADIATOR & Standard Sanitary
New York CORPORATION Pittsburgh
PRACK & PRACK, ARCHITECTS AND ENGINEERS, PITTSBURGH, PA.

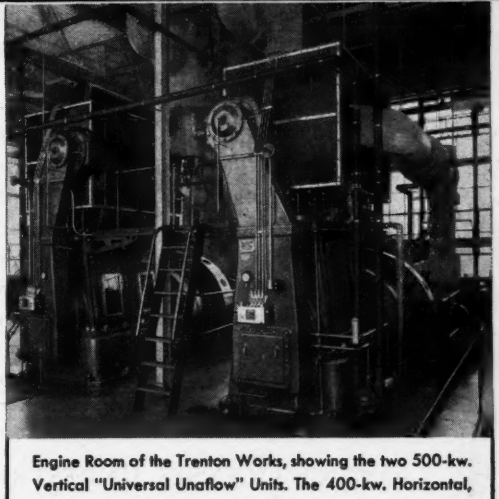
THE Trenton Works of the American Radiator & Standard Sanitary Corporation is a landmark to travelers on the Pennsylvania Railroad between New York and Philadelphia. It was originally the plant of the Thomas Maddock's Sons Company. In 1929 the plant and business were purchased, and in 1940 it was necessary to double the size of the plant.

This big pottery, producing "Standard" Vitreous Plumbing Fixtures, covers 597,450 sq. ft. It is the last word in efficiency. Raw materials are delivered at one end of the plant and, in a continuous flow through pug mills and tunnel kilns, come out at the other end ready to be loaded on the cars for shipment to all points of the compass.

In 1925 two Skinner Horizontal "Universal Unaflow" Steam Engines, of 400-kw. and 200-kw. capacity were installed in the original Maddock's plant. The enlarged plant naturally required more power, and also, naturally, two new 500-kw. Skinner "Universal Unaflow" Engines, two-cylinder vertical type, were selected to do the job. The 400-kw. engine has been retained for reserve power, while the 200-kw. is still functioning efficiently for another owner.

Our associations with the companies now embodied in the great "American-Standard" Corporation extend back well toward the last century. Today six Skinner "Universal Unaflow" Engines are furnishing power in four of their plants: at Trenton, N. J.; Bayonne, N. J.; Elyria, Ohio; and Litchfield, Ill.

This is another illustration of the fact that "Universal Unaflow" Engines make friends—*and keep them.*



Engine Room of the Trenton Works, showing the two 500-kw. Vertical "Universal Unaflow" Units. The 400-kw. Horizontal, at the right of these two, could not be shown in picture.

Some Users of "UNIVERSAL UNAFLOW" ENGINES

Hotels, Clubs	Leather Products
Schools and Colleges	Furniture & Woodworking
Hospitals, Homes	Printing, Publishing
Public Institutions	Paper, Paperboard
Department Stores	Laundries, Cleaners
Office Buildings	Oil Refineries
Railroads	Stone and Brick
Meat Packing	Gas Plants
Dairies	Municipal Water & Electric Plants
Breweries	Cotton Oil Mills, Gins
Food Products	Rubber
Ice & Cold Storage	Glass
Mining	Bakeries
Chemical, Ordnance	Tobacco
Drugs and Soaps	
Machinery Mfrs.	
Textiles	

ARMY E NAVY

Proudly we fly the Army-Navy "E" Flag, awarded for excellence in production

Do More Than Before—Buy EXTRA War Bonds

For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

Patent Notice

Please take notice that United States Patent No. 2,358,222 issued September 12, 1944, has been assigned to National Aluminate Corporation. For your convenience, claims 1 and 15 are reproduced below as being somewhat typical of the 19 claims of this patent:

1 In the art of treating water for industrial consumption, the process of inhibiting deposition of alkaline earth compounds in passageways for the water having a total alkalinity that does not exceed the soap hardness by more than one hundred parts per million, expressed as $CaCO_3$, comprising, adding to the water, a polyphosphoric acid compound in an amount not exceeding nine parts per million and not exceeding thirty-five percent of the soap hardness of the water.

15 The herein described process of treating and heating a water which would otherwise precipitate calcium carbonate upon heating, which comprises, adding to the water a water-soluble molecularly dehydrated phosphate which has a dispersive effect upon calcium carbonate in an amount much less than that required for softening the water and not more than about 9 parts per million but sufficient to prevent the precipitation of calcium carbonate as a result of heating the water together with an organic dispersive agent which has a dispersive effect upon calcium orthophosphate, and thereafter heating the water so treated.

PATENT LICENSES, UNRESTRICTED AS TO SOURCES OF SUPPLY AND MATERIALS, BUT ON A ROYALTY BASIS, WILL BE GRANTED TO THOSE DESIRING TO PRACTICE THE SUBJECT MATTER OF UNITED STATES PATENT 2,358,222. APPLICATIONS FOR LICENSES SHOULD BE MADE TO NATIONAL ALUMINATE CORPORATION, 6218 WEST 66th PLACE, CHICAGO 38, ILLINOIS.

Softened boiler feedwater at 200° F run through tube for 1 hour — incrustration 137 milligrams.

Same feedwater stabilized at same temperature run through tube for 1 hour — incrustration 1 milligram.

Nalco

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 **Automatic Ash Disposal System**—How the Durabilt vacuum ash conveyor removes ash from dust collectors, boiler passes, ash pits to storage tank, gondola or pile, is explained in Bulletin No. 1244. Chicago Fire Brick Co.

2 **Fuel Oil Pumping** — Bulletin OB-37 provides 16 pages specifications and illustrations of various equipment arrrangements built into a complete unit system to handle all grades of fuel oil as required for every type of oil burner. The Engineer Co.

3 **Forced Recirculation Boiler**—Simplicity of field erection, integral water-wall furnace construction, quick starts and rapid load changes, and other features of the International-LaMont LFS forced recirculation boiler are described in new bulletin. Curves show performance characteristics. The International Boiler Works Co.

4 **Coal and Coke Conveyor** — Bulletin No. 462 describes Rex apron and pan feeders and conveyors for handling coal, coke, ore, cement, rock, chemicals, bulk parts and many other materials. Contains design details, cross sections, capacity tables and specifications tabulated for quick comparison. Chain Belt Co.

5 **Refractory Coating** — Literature tells how Brickseal refractory coating prolongs the life of new or old brickwork by preventing disintegration due to cracking, spalling, slagging. Applied with brush or spray gun. Brickseal Refractory Co.

6 **Pneumatic Spreader Firing** — Latest bulletin on Iron Fireman pneumatic spreader stoker contains full descriptions, capacities, operating data, with layouts and photos of ten actual installations. Iron Fireman Mfg. Co.

ELECTRICAL

7 **High Voltage D-C Supply** — Bulletin GEA-4317 describes a metal enclosed portable unit to provide high voltage d-c power for applications such as: Testing equipment, Precipitation, Induction Heating, Radio and Electronics. General Electric Co.

8 **Hints on Wiring Maintenance** — A practical working program to keep your electrical system in condition is outlined in a Preventative Maintenance book issued by Anaconda Wire & Cable Co. Also contains wiring diagram symbols, hints on motor selection, routine tests, etc.

9 **Portable Infrared Units** — How the Fostoria Infrared lamp is used for baking insulation varnish on small motors, thawing frozen pipes, removing paint, heating oil valves, etc., is described in new bulletin. The Fostoria Pressed Steel Corp.

10 **Lighting Maintenance Tips** — New booklet has illustrations and check charts on how to get more light at no extra cost, cleaning, inspection, painting, easy test methods. Covers various types of lamps in industrial plants. Westinghouse Electric & Mfg. Co.

11 **Industrial Electronics** — Publication GEA-4309, "Fundamentals of Industrial Electronics," 44 pg, gives the reader a good working knowledge of principles involved; shows electronic tubes used as rectifiers and amplifiers, in counting devices, motor reversing and many other practical applications. General Electric Co.

12 **Mica Ceramic Insulation** — Mykroy Bulletin 102 describes the new, larger size sheet of glass bonded mica ceramic insulation now available. This high frequency insulation is ideal for: switchboard panels, large inductance bars, large meter panels, etc. Electronic Mechanics, Inc.

13 **Protected Type Motor**—A new Protected-Type motor, designed for both drip-proof and open motor applications, is described in a bulletin by the Crocker-Wheeler Div. of Joshua Hendy Iron Works. Cutaway view of the motor, illustrating the various design features, is included to show how this construction provides protection against many of the common operation hazards.

14 **Fluorescent Lighting Handbook** — A 16-pg catalog, "Bestran Ballasts for Fluorescent Units," describes a new technique in ballast construction—the Bestran ballast. Because of its Bi-Way lead, this ballast becomes a universal model, interchangeable with any other ballast of like rating, suitable for both industrial and commercial fixtures. Catalog has tips for obtaining top service from fluorescent lighting equipment, wiring diagrams, and other handbook data. Hudson-American Corp.

14A **Rotary Converters** — New bulletin describes electrical and mechanical features of Janette rotary converters; also gives helpful data on application to lamps, motors, heating devices, etc. Janette Mfg. Co.

FANS, PUMPS, COMPRESSORS

15 **Pointers on Pump Maintenance**—Wall card, 9 by 12 in., lists eight practical pointers on steam pump maintenance. Applies to all makes. Worthington Pump & Mach. Corp.

16 **Pump for Limited Npsh**—A vertical multi-stage pump, designed for handling liquids—hot or cold—corrosive or non-corrosive—where the net positive suction head is limited, is described in a new bulletin of Byron Jackson Co. Contains illustrations of pump handling light petroleum fractions, in condensate return service and for heater drip pumping. Capacities of standard sizes are to 1000 gpm, against heads up to 250 psi.

17 **Pump Bulletins**—Details on Warren pumps are contained in Bulletins 228 and 229. Dimensional data, capacities, etc., on a complete line of centrifugal, liquor duplex and single piston, plunger, vacuum, etc., will help you to find the pump to fit your particular needs. Warren Steam Pump Co.

18 **Forced Draft Blowers** — Condensed bulletin covering Wing forced draft blowers, both turbine driven and motor driven, and Wing Auxiliary Turbines, has been issued by L. J. Wing Mfg. Co. Information includes photographs of installations, capacity curves, dimension tables and operating data.

INSTRUMENTS AND CONTROLS

19 **Automatic Coal Scales**—Catalog 1143 contains illustrations and technical data on a line of dustproof coal scales which will furnish precise figures on coal consumption, steam cost and boiler efficiency. Richardson Scale Co.

20 **Ring Balance Flow Meters**—Bulletin T44 explains principle of operation of Ring Balance mechanical flow meters. Changing meter capacities is said to be easy as changing weights on scale. Ring Balance Instrument Co.

21 **Engine Alarm System**—Data Sheets tell how Viking alarm systems guard against engine breakdown when circulating water temperature is too high or oil pressure is too low. Viking Instruments Co.

22 **Combustion Controls** — Folder tells about the Perfex combustion control, draft gage and other instruments that make for increased efficiency in steam generating plants of factories, hotels, office buildings, etc. Perfex Corp.

23 **New Type Flow Indicator**—Described in new Bulletin 92-C is the Rotasight flow rate indicator. This instrument operates on the rotameter area-type principle and has a V-ported transparent metering tube with a float which rises in direct proportion to the flow through the meter. Bulletin explains construction details and applications; also gives engineering dimensions, flow capacities and prices. Fischer & Porter Co.

24 **All-Electric Floatless Controls**—Operation and applications of B/W floatless liquid level controls are explained in Catalog No. 145. These controls use induction relay; may be used on general purpose, boiler feed, condensate, sump pumps, etc., as long as the material is a conductor of electricity. B/W Controller Corp.

PIPING, VALES AND FITTINGS

25 **Automatic Control Valves**—New Catalog No. 26 describes design and operation of Golden-Anderson triple-acting non-return and other types of automatic control valves. Also contains table of water heads with equivalent pressures and other useful engineering data. Golden-Anderson Valve Specialty Co.

26 **Pressures on Welding Fittings**—A 20-pg. booklet issued by Tube-Turns, Inc., gives allowable working pressures for welding fittings in five classes of piping—power, oil, district heating, gas and air, and refrigeration. Fourteen convenient tables list allowable pressures at the indicated temperatures for any size and weight Tube-Turn fitting.

27 **Steam Trap Handbook**—Tables, charts, diagrams and rules for selecting traps, giving complete explanations, make the new 36-pg Armstrong Steam Trap Book a handy reference volume for every engineer's library. Armstrong Machine Works.

28 **High Pressure Valves**—Bulletin No. 5 pictures the simple and fast-operating emergency closing feature of the Ludeman Du-al high pressure valves. No packing, rings, or friction. Ludeman Valve Div., Skinner Engine Co.

Coupon must be filled in completely to secure literature you request. Pasting coupon on penny postcard saves time and money.

MARCH, 1945

POWER PLANT ENGINEERING
53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation the literature indicated by the following paragraph numbers:

.....

.....

.....

Your Company
Name .....

Company
Address .....

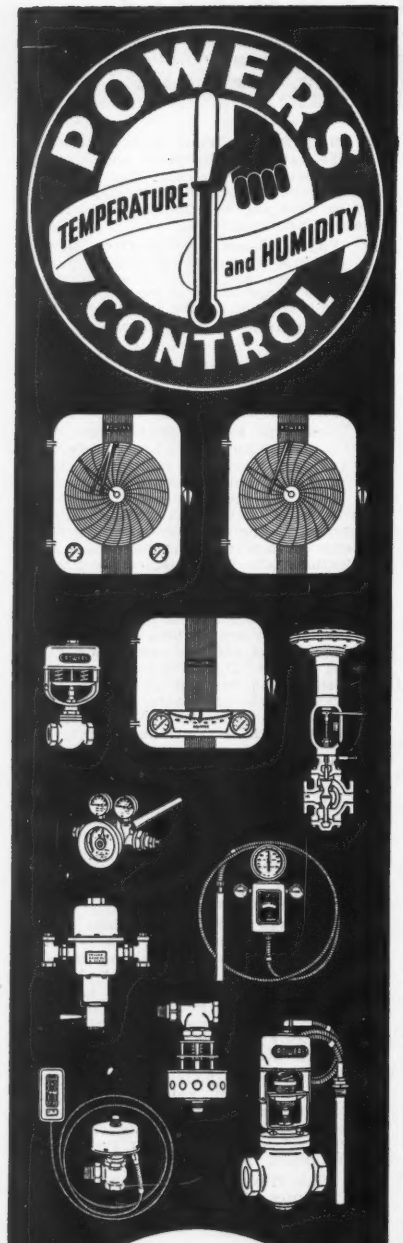
Your
Name .....

Your Title .....

City ..... State .....
(If you prefer delivery at your home also fill in below)

Home
Address .....

City ..... State .....



When you want accurate and dependable automatic temperature or humidity control for Industrial Processes, Heating or Air Conditioning Systems, call in a Powers engineer. With over 50 years of experience and a very complete line of self-operating and air operated controls we are well equipped to fill your requirements.

Write for Circular 2520
2746 Greenview Ave., Chicago
Offices in 47 Cities—See your phone directory.

THE POWERS REGULATOR CO.

PRIME MOVERS

29 **Steam Engine Data**—Bulletin No. 306 gives sectional drawings, construction details and operating information on Troy-Engberg steam engines; discusses savings possible with by-product power. Troy Engine & Machine Co.

30 **Mechanical Drive Turbines** — Elliott mechanical drive turbines, type CY, with built-in reduction gearing, are discussed in Bulletin H-15. The single-stage mechanical drive turbine with built-in reduction gear combines the standard Elliott CY turbine with a specially built vertically-offset gear. Elliott Co.

31 **Turbine Oil Booklet**—Answers such questions as: what causes turbine oil deposit or sludge; what is an oxidation inhibitor—how does it prevent acidity; and what causes corrosion in turbines. Send for your copy. Standard Oil Co. (Indiana).

31A **"Barometric Condenser Data** — "Barometric Condensers" is the title of a new bulletin announced by Ingersoll-Rand Co. It covers both the disc-flow and ejector-jet types, explaining the uses, advantages and operation of each. Schematic diagrams illustrate how these vacuum-producing systems work and a number of photographs show the condensers in various industries such as chemical, fertilizer, sugar and power plants. These condensers are suitable for any vacuum service where it is not necessary to reclaim the condensate.

MISCELLANEOUS

32 **Sump Tank Cleaner** — Bulletin tells how the Carnes sump tank cleaning machine gets out all sludge, chips, oil and coolant in less than ten minutes. Gives complete specifications. W. R. Carnes Co.

33 **Extinguishers for Oil Tank Fires**—New folder describes the various types of foamite applicators for oil tank fires, now made available by the Government release of aluminum. American-La France-Foamite Corp.

34 **Hints on Plant Maintenance**—How Lumnite, a special hydraulic cement, is used for wear resistant linings in ash pits, coal bunkers, steel stacks, baffles, etc., is explained in reprint of article "Deterioration and Maintenance of Power Plant Structures." Atlas Lumnite Cement Co.

35 **Packing Data Book** — Latest 44-pg France Catalog offers useful data on packing designs for any service, installation methods, pressures and temperatures, oil return and stripping rings. The France Packing Co.

36 **Centering Head**—How the Boyce centering head may be used to measure degree of any angle or bend on outside or inside of any circumference, determine declivity of any flat surface, etc., is described in new folder. A time-saver for pipe and layout work. Eastern Research & Eng. Co.

37 **Cooler Performance Data** — Bulletin No. 5322, 28 pg, illustrates the operating features of Ross Types CP and CF coolers for lubricating oil, cutting oil, transformer oil, engine jacket water, etc. Also includes helpful charts and tables on cooler performance. Ross Heater & Mfg. Co.

38 **Absorption Refrigeration Machine**—With flow diagrams and text, Bulletin C-1100-B8 explains the basic principle of the simple ammonia absorption refrigeration unit. Photos of typical applications also shown. Worthington Pump & Mach. Corp.

39 **Care of Heat Exchangers**—With cartoons and concise explanations, a new 12-pg booklet, "Care and Handling of Heat Exchangers," offers many practical operating and maintenance suggestions. Corrosion control is discussed in concluding chapter. The Whitlock Mfg. Co.

40 **Aero Steam Condenser**—Bulletin No. 99 shows an easy-to-understand color diagram of the new Niagara aero steam condenser. Niagara Blower Co.

41 **Color Guide for Industrial Plants**—Simplified color selection guide offers practical hints on the use of colors for pipe identification, for walls, machinery, etc., to increase plant safety and worker efficiency. The Arco Company.

This *New* OAKITE DIGEST Gives You

PREPARED PARTICULARLY FOR BUSY ENGINEERS AND SUPERINTENDENTS who supervise power plant operation, this new Oakite Digest concisely describes successful methods for handling 71 different, commonly recurring maintenance and related power plant cleaning jobs.

The Oakite Digest gives simple, easy-to-follow instructions for speeding up and simplifying maintenance cleaning on such equipment as:

Transformers
Heat Exchangers
Lube Oil Coolers
Condensate Meters
Feedwater Heaters
Surface Condensers
Diesel Cooling Systems
Refrigerant Condensers

Write now for your FREE copy of this practical guide. No obligation, of course.

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE Buy Bonds for Victory
Specialized cleaning
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

FOOTSTEPS

leading to Scientific Feedwater Service

Six steps follow the pathway to properly conditioned boiler water in the Dearborn water treatment plan:

Step 1 . . . The Dearborn Engineer studies your water and plant operation conditions.

Step 2 . . . He sends samples of your water to the main laboratory for analysis.

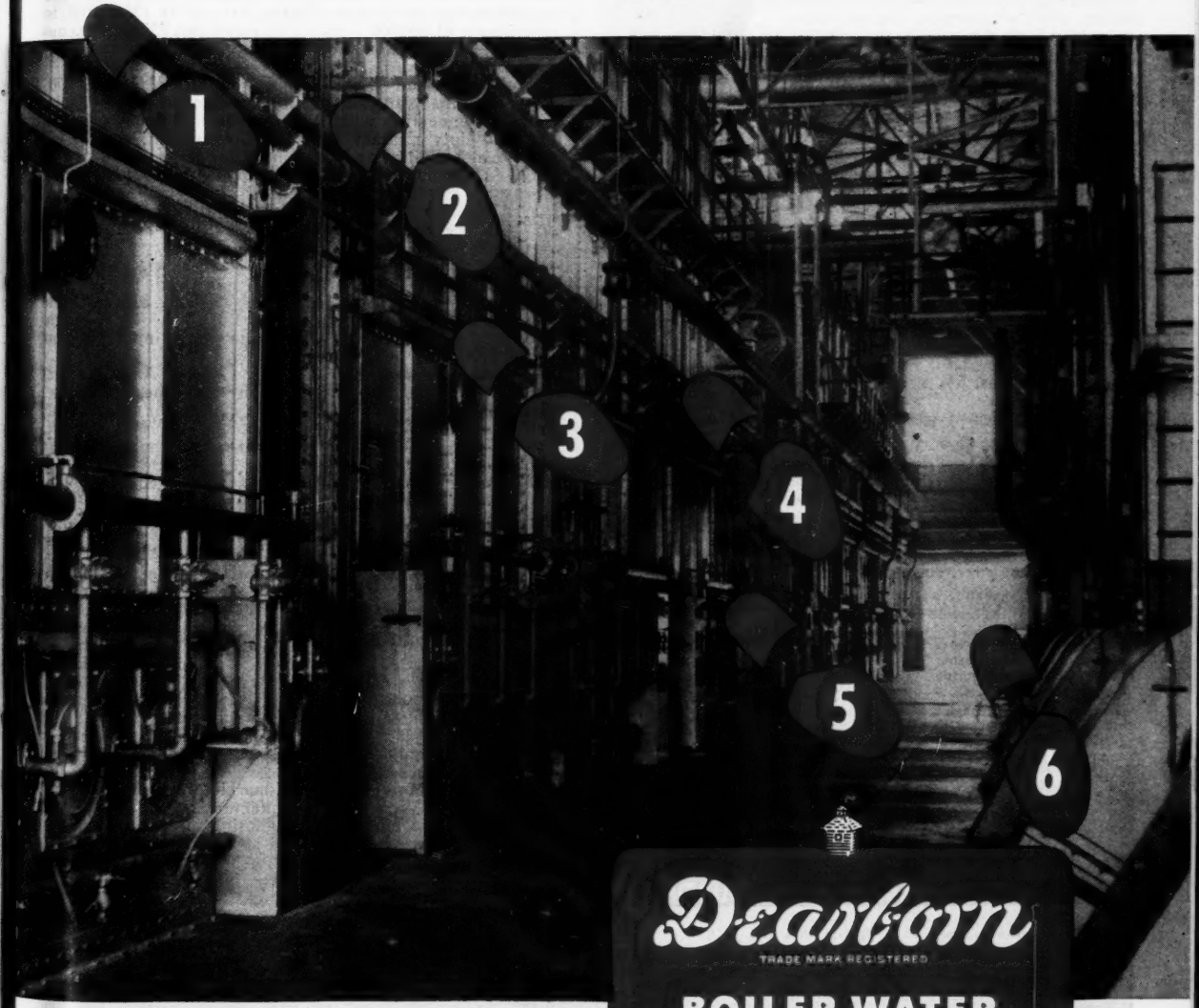
Step 3 . . . Recommends proper chemical treatment and chemical control methods.

Step 4 . . . Supervises installation of feeding equipment in your plant.

Step 5 . . . Instructs your men on water test methods for treatment, dosage adjustment, and blowdown control.

Step 6 . . . Calls regularly to insure maintenance of recommended conditions.

The Dearborn Engineer in your vicinity knows your local water characteristics because he lives and works there. He will be glad to serve you in formulating a balanced treatment program for your plant.



DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave.
Chicago 4, Illinois

NOW

How to get the most out of

AIR COMPRESSORS

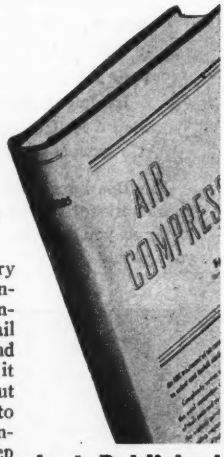
shown in the complete practical guide to efficient and economical

Selection

Installation

Operation

Maintenance



Here is a priceless new manual for every design, plant, or operating engineer concerned with machines and processes involving air compressors. In great detail and the clearest kind of language, and with over 400 explanatory illustrations, it tells everything you need to know, about all types of compressors, in order to choose the right kind for a specific installation and to put it in service, keep it in service, and get the most out of it.

Just Published

AIR COMPRESSORS

By EUGENE W. F. FELLER

Operating Engineer, formerly Assistant Chief Operator, Safe Harbor Water Power Corp., Associate Editor, *Power*

460 pages, 5⅛ x 8¼, 414 illustrations, $4.50

Here's a brief idea of what this helpful book gives you:

—information on the kinds of compressors available, with the pointers on performance, service limitations, etc., needed in selection

—complete mechanical description of every part of reciprocating, two impeller, sliding vane, liquid piston, centrifugal, and axial compressors

—full explanation of load-control devices, compressor lubrication requirements, and other special topics

—instructions and diagrams on location, foundation, erection, alignment, adjustment, and other details of compressor installation

—directions for operating all types of compressors, with special attention on trouble points to watch

—maintenance helps, covering everything from minor adjustments to the making and fitting of piston rings

Procedure for lining up rotating shafts—convenient separate chapter of air compressing theory—material on hydraulic air compressing—comparative costs and pointers on compressor selection—these are other helpful features of this exceptionally thorough and practical manual.

Includes a complete description of the **GAS TURBINE** of which the axial compressor is a necessary accessory, giving you an up-to-the-minute view of the features of this formidable newcomer in the field of power generation.

See it 10 days FREE—Send this coupon

McGRAW-HILL FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y.

Send me Feller's Air Compressors for 10 days' examination on approval. In 10 days I will send $4.50 plus few cents postage or return book postpaid. (Postage paid on cash orders.)

Name .....

Address .....

City and State .....

Company .....

Position ..... PPE 3-45

(Books sent on approval in United States only.)

POWER PLANT *Construction News*

Ala., Tuscumbia—Robbins Tire & Rubber Co., Inc., plans installation of electric power equipment in connection with expansion in mill for production of heavy-duty tires for military trucks and vehicles for Government, comprising additional buildings, with machinery for considerable increased capacity. Cost estimated about $500,000. Financing in that amount will be furnished by Defense Plant Corp., Washington, D. C., Federal agency. Work will begin soon.

Calif., Los Angeles—Bureau of Power and Light, 207 South Broadway, plans extensions in power substation "A", as a postwar project, including installation of a new synchronous condenser, estimated to cost about $350,000; additional transformer bank and switchgear, to cost approximately $740,000; additional receiving feeder lines and miscellaneous equipment. Entire project is estimated to cost about $1,300,000. Also will carry out similar expansion at power substation "D", to cost approximately $800,000.

Calif., Oakland—Pacific Rubber & Tire Mfg. Co., 4901 East 12th St., plans installation of electric power equipment in connection with expansion in mill for production of heavy-duty military tires for Government, comprising additional buildings and machinery for large output. Cost about $1,000,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will be placed under way soon.

Calif., Pasadena—Municipal Light and Power Department, 100 North Garfield Ave., has preliminary plans under way for postwar expansion in steam-electric generating station, including installation of additional turbine-generator units and accessories, to cost about $735,000, and addition to steam division, with installation of new high-pressure boilers and auxiliary equipment, estimated to cost about $600,000.

Conn., New Haven—Wire Rope Corp. of America, Inc., 464 Congress St., manufacturer of wire rope, cable, etc., plans installation of electric power equipment in proposed new plant on State St., where tract of land, 700 x 1500 ft., has been acquired. Project will comprise a main one-story manufacturing building and several auxiliary structures, and will be carried out as a postwar project. A boiler house is planned. No official estimate of cost as yet announced. Leo F. Caproni, 1221 Chapel St., New Haven, is architect.

Ill., Rock Island—Iowa-Illinois Gas & Electric Co., Rock Island, has plans under way for expansion and improvements in plants and system during present year, if priority ratings are secured, including extensions in different generating stations, with equipment installation for increased capacity, additions in transmission and distributing lines, power substations and other facilities. Entire program is reported to cost over $2,500,000.

Ind., Anderson—Nicholson File Works, Arcade File Works Division, is said to be planning new power plant at local factory as a postwar project, reported to cost over $90,000, with equipment. Main offices of parent company are at Providence, R. I.

Iowa, Des Moines—New Monarch Machine & Stamping Co., 406 S. W. 9th St., manufacturer of machinery and hardware products, plans installation of electric power equipment in new two-story and basement plant, 120 x 140 ft., to be used, it is understood, for production for Government. Cost over $125,000 with machinery. Bids are being asked on general erection contract. Kraetsch & Kraetsch, Davidson Bldg., Des Moines, are architects.

Iowa, Hawarden—Municipal Electric Department has authorized plans for extensions and improvements in municipal power station, including installation of new Diesel engine-generator unit of about 1000-hp. rating, and auxiliary equipment. Cost reported approximately $100,000. It is understood that this will be a postwar development. Buell & Winter Engineering Co., Insurance Exchange Bldg., Sioux City, Iowa, is consulting engineer.

Minn., Delano—Municipal Power Department has authorized surveys and estimates of cost for expansion in municipal power plant, including installation of new 1200-hp Diesel engine-generator unit and accessories. Project will be a postwar development. Ralph D. Thomas & Asso-

BULK-FLO *Solves a Coal Handling Problem in Wire Plant Boiler Room*

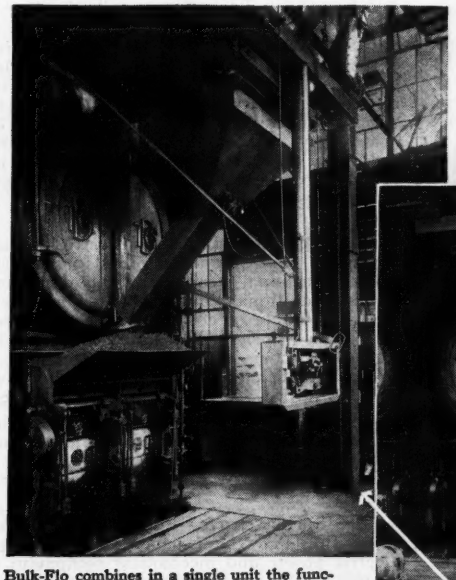
MODERNIZING the coal handling system of the Atlantic Wire Co. boiler room not only made it more efficient and more nearly automatic, but solved the problem of providing better working conditions as well.

With the previous method, coal was delivered to the 170 HP boilers by means of an overhead monorail electric hoist system, with hand propelled trolley equipped with 380 lb. capacity bucket. This resulted in considerable dust and the necessity for manual labor.

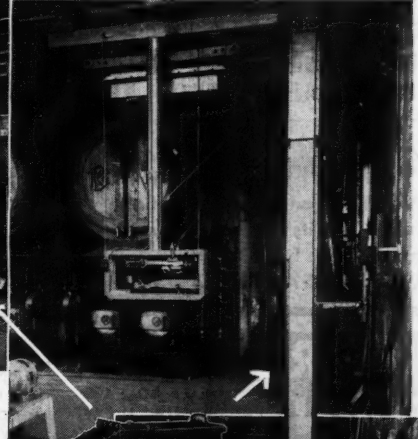
With the Bulk-Flo conveyor-elevator, the coal storage pit is outside the boiler room wall. Slide gates in the wall lower the coal to the horizontal section of the Bulk-Flo. The vertical section delivers the coal to a suspended weigh larry, equipped with chute to hand-operated undercut gate to regulate discharge to stoker hopper. The weigh larry also has an electric vibrator to prevent wet coal from sticking to the inside walls. Link-Belt is prepared to help you solve similar problems. Send for Catalogs.

LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in principal cities.



Bulk-Flo combines in a single unit the functions of an elevator, a conveyor and feeder . . . with extreme flexibility of layout for coal and other flowable materials.



At left: Vertical run of Link-Belt Bulk-Flo; boilers; and hand-propelled weigh larry. Below: Wall gates and chutes to horizontal run of Link-Belt L-path Bulk-Flo conveyor-elevator.

9835

LINK-BELT
Bulk-Flo
ELEVATOR-CONVEYOR-FEEDER

STOP...

Ripping up your old wood flooring... Chopping rutted and broken concrete... Expensive labor and delays

The problem of maintaining factory floors, driveways, trucking aisles and platforms is greatly reduced and operating efficiency increased when ruts and holes are eliminated *The One Easy Way.*

STONHARD RESURFACER is sparkproof, non-slipping, non-dusting, fire- and water-resistant. Bonds perfectly to feather-edge over concrete, wood, brick or composition.

The more punishment STONHARD RESURFACER receives under heavy traffic the more it compacts without chipping.

A complete overlay or patch with STONHARD RESURFACER will give you *a smooth, tough, and resilient surface* that is long-lasting and will withstand the heaviest trucking and traffic.

YOUR OWN WORKMEN CAN APPLY STONHARD RESURFACER EFFICIENTLY

ORDER A DRUM NOW

Complete Overlays and Repairs with STONHARD RESURFACER
Over Concrete... Wood... Brick... Composition

30 OTHER STONHARD BUILDING MAINTENANCE MATERIALS FOR EVERY BUILDING MAINTENANCE NEED.

TRIAL OFFER: **We will send a drum of STONHARD RESURFACER to any responsible firm on our trial basis . . . test its performance under actual working conditions for 30 days. . . . NO CHARGE UNLESS SATISFACTORY.**

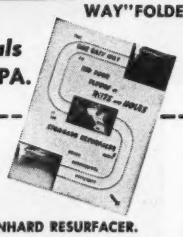
STONHARD COMPANY

Established in 1922

Building Maintenance Materials

401 N. BROAD ST., PHILADELPHIA 8, PA.

SEND FOR THE NEW "ONE EASY WAY" FOLDER



STONHARD COMPANY
811 Terminal Commerce Bldg.
Philadelphia 8, Pa.

Sirs: Please send me your new "One Easy Way" Folder and detailed information on STONHARD RESURFACER.

Our floors are: Concrete ☐ Wood ☐ Brick ☐ Composition ☐

FIRM _____

MR. _____ TITLE _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

ciates, Inc., 1200 Second Ave. South, Minneapolis, Minn., is consulting engineer.

Mont., Laurel—Great Northern Railway Co., Great Northern Bldg., St. Paul, Minn., has plans for new steam power plant at shops at Laurel, comprising boiler house, engine room, coal and ash-handling equipment, water-softening apparatus and miscellaneous equipment. Cost estimated close to $400,000. A priority rating has been secured and work will begin soon.

Nev., Las Vegas—Steel Conversion Corp., Las Vegas, plans installation of electric power equipment in new one-story mill on Bonanza Rd., about 75 x 250 ft. Cost reported close to $100,000, with equipment. It is proposed to begin work soon. Project has a priority rating. Richard Stadleman, Hotel Last Frontier, Las Vegas, is architect.

N. M., Carlsbad—Southwestern Public Service Co., Amarillo, Tex., has plans maturing for expansion in generating station at Carlsbad, including addition to present building and installation of equipment for increased capacity. Cost estimated close to $1,000,000. It is understood that application has been made for a priority rating.

N. Y., Watervliet—Adirondack Foundries & Steel, Inc., James St., manufacturer of steel castings, etc., plans installation of electric power and mechanical-handling equipment in connection with expansion in plant for production for Government, including additional building with machinery for increased output. Entire project will cost about $115,000. Financing will be provided by Defense Plant Corp., Washington, D. C., Federal agency.

Ohio, Marysville—H. B. Salter Mfg. Co., Marysville, manufacturer of plumbers' brass goods, etc., plans installation of electric power equipment in new one-story plant on local site, to be about 140 x 360 ft. Cost reported over $160,000, with machinery. Project has a priority rating and erection will begin soon.

Pa., Conshohocken—Lee Rubber & Tire Co., will make extensions and improvements in power plant at mill, with installation of additional steam and electric equipment for increased capacity. Project will be carried out in connection with a mill expansion program for larger output of heavy-duty tires for Government, including new addition and installation of machinery for such purpose. Entire project will cost approximately $600,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency.

Pa., Ephrata—Municipal Electric Department, 21 East Locust St., has completed plans for new steel frame addition to municipal steam-electric power plant, with installation of additional equipment for increased capacity. No official estimate of cost announced. Project is understood to have a priority rating and work will be placed under way soon. Louis T. Klauder & Associates, Lincoln Liberty Bldg., Philadelphia, Pa., are consulting engineers.

Pa., Pittsburgh—Jones & Laughlin Steel Corp., 3rd and Ross Sts., will make extensions and improvements in boiler house at mill, including installation of additional primary and auxiliary equipment. Cost reported about $450,000. A priority rating has been secured and work will begin soon.

Pa., Spring Grove—P. H. Glatfelter Co., manufacturer of writing and other paper stocks, plans installation of electric power and mechanical equipment in new addition to mill, to be used as an evaporator unit. Cost reported over $90,000, with machinery. Project is understood to have a priority rating and work will begin soon. H. M. Wilson Co., 18th and Brandywine Sts., Philadelphia, Pa., is engineer.

Wis., Milwaukee—Shell Oil Co., 624 South Michigan Ave., Chicago, Ill., plans new bulk oil terminal on Jones Island, Milwaukee, comprising several buidings for storage and distribution of oil, gasoline, etc., with battery of steel storage tanks of 10,000,000 gal. gross capacity, pumping station and other mechanical facilities. Cost reported about $500,000. Proposed to make application for a priority rating.

Wis., Port Washington—Wisconsin Electric Power Co., 231 West Michigan St., Milwaukee, Wis., has plans under way for expansion in steam-electric generating station at Port Washington, including addition to present building and installation of new 80,000-kw turbine-generator, high-pressure boiler and auxiliary equipment. Switchyard will be enlarged and extensions made in transmission lines. Entire project is estimated to cost in excess of $7,000,000. Application has been made for a priority rating and work is scheduled to begin in spring if authority is secured.

ONE HUNDRED BILLION BUGS TURN UP TOES!

U. S. Navy Orders 40 Carloads of Insecticide Judged "Essential" as Health Insurance for Armed Forces!

Bowser Can Filling Unit Fills 450 1-Gallon Cans Every Hour!

* * *

When a large eastern chemical manufacturer received an order from the Navy for 40 Carloads of insecticide (320,000 gallons) an acute problem arose. How could they fill 320,000 1-gallon cans quickly in order to meet delivery dates? Prompt delivery was vitally important as the insecticide was to be used to destroy all types of vermin aboard ship and on shore.

The problem of high-speed filling was solved quickly when this company installed a Bowser can filling unit equipped with a temperature and specific gravity adjustment dial. Thus Bowser equipment met all rigid Navy specifications which demanded that every can be filled according to **weight**. With this equipment and in spite of the small size of the can openings, inexperienced girls were able to fill better than **450 1-gallon cans an hour!** This same Bowser Equipment has also been used for filling 5-gallon benzol cans and 1-gallon cans of Xylol and Xylene—also delivered in carload lots.

In the power field as well as in the chemical field, Bowser produces important labor and money-saving devices . . . for example, Bowser Turbine Oil Conditioners, Force Feed Lubricators and other liquid control units. A problem in your plant? If so, a Bowser engineer will be glad to consult with you. No cost or obligation. Write today. BOWSER, INC., Dept. 4-C, Fort Wayne 2, Indiana.

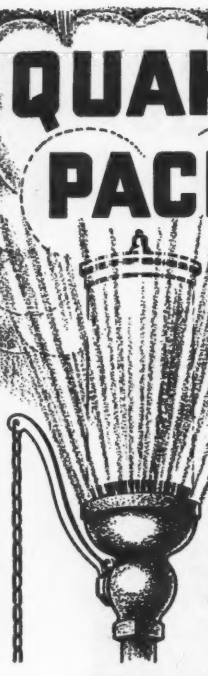
Not only has Bowser's war production earned the Army-Navy E . . . Bowser equipment has helped earn it for scores of other companies.

THE NAME THAT MEANS EXACT CONTROL OF LIQUIDS

BOWSER

SINCE 1885

QUAKER PACKINGS



Wherever there is steam to be kept under control there is a style and type of Quaker Rod and Sheet Packing to suit the particular condition.

Specify QUAKER

Make sure you get the proper packings that will give you the best results—see that your orders specify QUAKER. And remember there is a Quaker Packing to meet any service condition, for it is *the* complete packing line.

For old equipment, for new equipment . . . for all kinds of service conditions . . . low pressures, or high pressures . . . cold water or steam . . . water, oil, acids or any other kind of liquid . . . air, steam, vapor or vacuum. Regardless of the service you may require, there is a Quaker Packing to meet that condition.

Consult Quaker if you have any packing troubles. Our Packing Experts are at your service any time.

If there is a way to get it done **QUAKER** *will do it*

Reg. U. S. Pat. Off.

QUAKER RUBBER CORPORATION

Mfrs. Industrial Rubber Products

PHILADELPHIA 24, PENNSYLVANIA

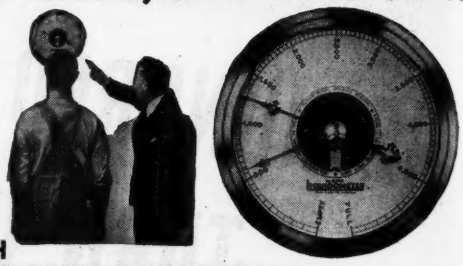
NEW YORK • CLEVELAND • CHICAGO • HOUSTON

Western Territory

Quaker Pacific Rubber Company

San Francisco • Los Angeles

ACCURATE LIQUID LEVEL INFORMATION AT A GLANCE, WHEN YOU WANT IT—



WITH

LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.

No pumps, valves, or auxiliary units needed to read them.

Models available for either remote or direct readings.

Accuracy unaffected by specific gravity of tank liquid.

Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

THE LIQUIDOMETER CORP.

36-31 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

NEW PRODUCTS WANTED

By

40 Year Old Manufacturer of

POWER PLANT SPECIALTIES

This manufacturer is an acknowledged leader in his field, has an exceptionally strong financial position and has a nationwide sales organization. He is interested in adding to his line of steam power plant specialties several new products with good postwar sales possibilities. He has a research organization capable of thoroughly testing new products and doing any additional development work found necessary. Write to

WITTE & BURDEN • ADVERTISING

5757 Cass Ave., Detroit 2, Mich.

ZURN PIPE LINE EQUIPMENT

An *You Can Use*

to Keep Pipe Lines Operating Continuously

WHAT SPECIFIC PROTECTION do your pipe lines require? That is where Zurn Engineering Service begins. Its first objective is to discern the exact protective function required of a pipe line unit under a specific service condition. This engineering service backed by over 40 years of broad technical experience, and the production of a wide range of power pipe line equipment provides devices for keeping pipe lines operating continuously. All products included in the Zurn line of Power Pipe Line Equipment meet A. S. M. E. requirements for metals used in pressure vessel parts.

Zurn Engineers are engaged continuously in the development of Pipe Line Equipment to meet ever-changing requirements of industrial and power plants for adequate protection of pumps, traps, regulators, injectors, control equipment and valves. Do not restrict your inquiries to the products illustrated, but write the Zurn Research and Development Department when you need a new device for a specific service, or standard equipment for a special installation. Ask a Zurn Pipe Line Equipment Engineer to keep your engineers up-to-date on developments of pipe line devices, their specification and installation.

● The Zurn Line of Pipe Line Equipment includes Duplex Strainers for high and low pressures; Pressure and Fluid Line Strainers; "Y" Strainers; Safety Vents; Discharge Check Valves; Remote Valve Control Assemblies, Interceptors for Wax, Grease, Fats, and other low density insolubles; Volatile Liquids Intercepting Drains; Solids Interceptors and Lint Interceptors. Zurn Catalog No. 45 illustrates, describes and gives dimensional data on this equipment. Attach coupon to your letterhead and mail today for your copy. Zurn Products also include a complete line of Roof Drains, Floor and Area Drains, Hydrants and Street Washers, to assure an efficient and protected drainage system for all types of buildings and areaways. Literature available upon request.

J. A. ZURN MFG. CO.

***Industrial Division* • ERIE, PA., U. S. A.**

ZURN Pipe Line Equipment Engineering Service Is Immediately Available to You by Request Direct to the Factory at Erie, Pa., U. S. A.

Form No. 45-38

ZURN

INDUSTRIAL AND POWER PLANTS, PROCESS INDUSTRIES

J. A. ZURN MFG. CO., Dept. PPE, Erie, Pa. U. S. A.
Please send me copy of Zurn Catalog No. 45 on Fluid Handling Equipment.

Name _____ Position _____

Company _____

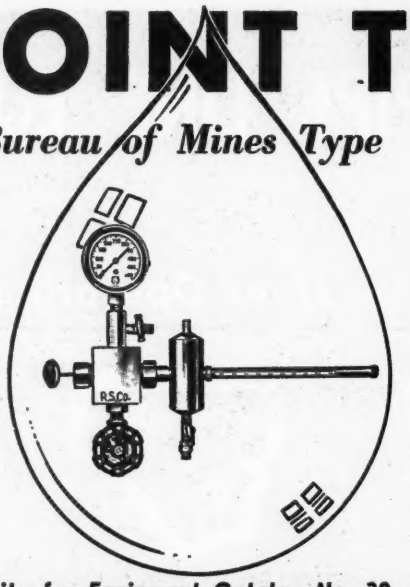
Address _____

City _____ State _____

DEW-POINT TESTER

Bureau of Mines Type

- Determines dew-point of gases under conditions of pressure as they are found to exist.
- Designed primarily for use in connection with high pressure gas transmission lines.



- Accurate within 0.2° F.
- Standard range 0 to 600 P. S. I.
- High Pressure range to 2,500 P. S. I.
- Easy to operate and easily adjusted.

Write for Equipment Catalog No. 30

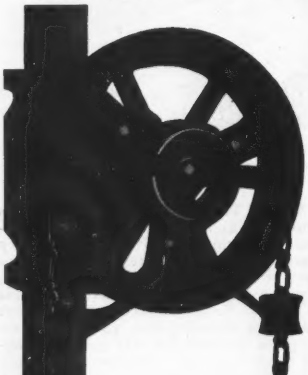
— SPECIALIZED TESTING AND MEASURING EQUIPMENT —

THE REFINERY SUPPLY CO.

Main Office and Plant

621 E. 4th Street **TULSA 3, OKLAHOMA** Ph. 4-8144, L.D. 581

Think of the TIME You'll Save



with Babbitt Sprocket Rims on all your "high-up" valves. No need of keeping a long, cumbersome ladder always on hand just to close a valve.

Babbitt Rims give you instant and positive control of overhead valves from the floor —save time, steam and accidents. Adjustable to any valve, easily attached and low in cost. Don't delay. Get your Babbitt Rims now! Complete information on request.

BABBITT STEAM SPECIALTY CO.

South Water, Spring and First Sts.

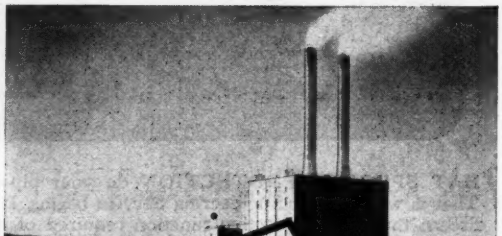
New Bedford, Mass., U. S. A.

Babbitt

—Adjustable—

SPROCKET RIM

with Chain Guide



One of America's Latest Stations

Coal Preparation by "Pennsylvania" Bradford-Hammermill

"Pennsylvania" STEELBUILT Coal Preparation Machinery, developed during the past 40 years, in six types and over 150 sizes, has been specialized for the requirements of Central Stations, Industrial Power Plants, By-Product Coke Plants, Mines and Coal Cleaning Plants.

Experience with a steadily increasing number of installations, with capacities now totaling well over 200,000,000 tons per annum, is the basis for our recommendations of efficient Coal Preparation Equipment, specialized for your requirements.

Our Engineers are at your service

PENNSYLVANIA CRUSHER COMPANY

1706 Liberty Trust Bldg., Philadelphia 7, Pennsylvania

New York, Pittsburgh, Chicago, Los Angeles, Birmingham

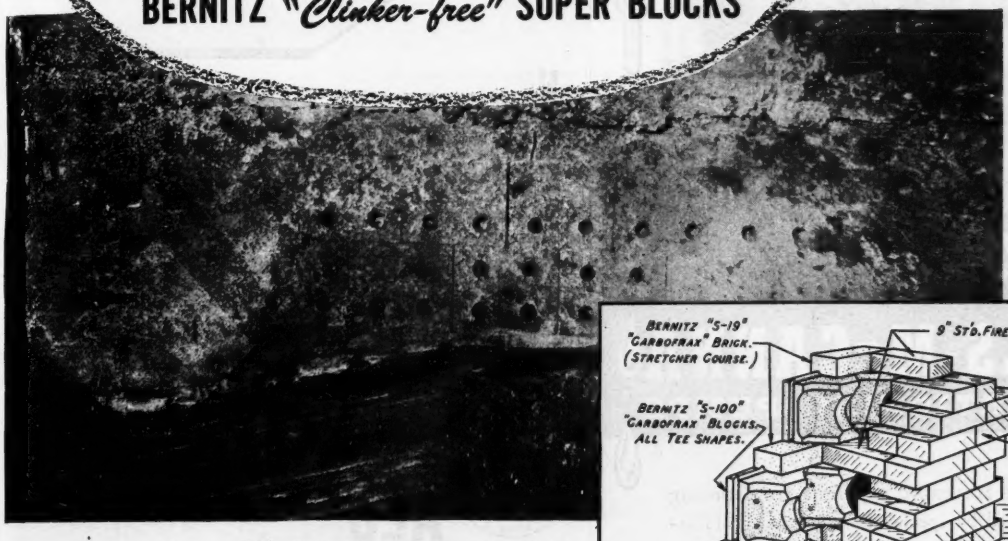
Associated with Fraser & Chalmers Engineering Works, London

THE PROBLEM:

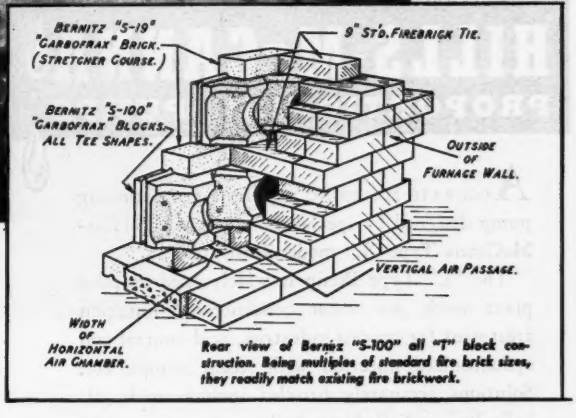
How to Simplify Small Boiler Maintenance

THE ANSWER:

BERNITZ "*Clinker-free*" SUPER BLOCKS



Bridgewall of single retort furnace—frequently inaccessible for cleaning.


BERNITZ "S-19" "CARBOFRAX" BRICK. (STRETCHER COURSE.)
9" STD. FIREBRICK TIE.
BERNITZ "S-100" "CARBOFRAX" BLOCKS. ALL TEE SHAPES.
OUTSIDE OF FURNACE WALL.
VERTICAL AIR PASSAGE.
WIDTH OF HORIZONTAL AIR CHAMBER.

Rear view of Bernitz "S-100" all "T" block construction. Being multiples of standard fire brick sizes, they readily match existing fire brickwork.

THE smaller stoker fired plant has the same furnace problems that beset the larger plant—perhaps to a greater degree.

The small plant may not have the advantages of automatic combustion control, water-cooled furnaces, or continuous ash discharging stokers. In this type of plant, labor is an important factor in the smooth and efficient operation of steam generating equipment. The more labor, the less time for attention to the job of burning coal efficiently.

BERNITZ SUPER BLOCKS are doing an outstanding job in hundreds of small plants—dairies, laundries, canneries, chemical plants, hospitals, and institutions of all kinds; in fact, in plants of all types where coal is burned, on stokers, and even on hand-fired grates.

BERNITZ AIR-COOLED SUPER BLOCKS keep the walls free of clinkers. "Carbofrax",* the silicon carbide refractory of which these super blocks are made, resists clinker adhesion. There is no penetration. The heavy labor of prying clinker away from the brickwork opposite the dumps is ended. Destruction of the brickwork at this point by bars is prevented, thus reducing maintenance.

Furthermore, the cleaning of fires is quickly accomplished, usually without loss of boiler capacity or time. Ask us to tell you about some installation near you.

Write for Bulletin B-344

* "Carbofrax" is the registered trade mark of, and indicates manufacture by, the Carborundum Company.

BERNITZ FURNACE APPLIANCE CO. • 89 BROAD ST., BOSTON 10, MASS.

New York Philadelphia Detroit Buffalo Syracuse Atlanta Pittsburgh Cincinnati Chicago Indianapolis Minneapolis St. Louis Cleveland
In Canada: Williams & Wilson, Ltd., Montreal and Toronto

BERNITZ SUPER BLOCKS

OTHER PRODUCTS INCLUDE:

- BERNITZ FURNACE LININGS
- BERNITZ NYGAARD WATER WALL BLOCKS FOR WALLS AND ARCHES
- BERNITZ AIR-COOLED FLOORS
- BERNITZ SUPERGENERATOR LININGS FOR WATER GAS SETS

ACCURATE DOSAGE

Calls for

HILLS-McCANNA
PROPORTIONING PUMPS

ACCURATE METERING requires a proportioning pump designed by specialists—such as the Hills-McCanna Type "L" model illustrated.

The "L" Type Pump is widely used in pilot plant work, for water conditioning, injection treatment for process industries, acid control and synchronized injection with steam pumps, etc. Solutions accurately handled include acids, alkalis, lime and oil slurry, boiler water compounds, dyes, fluids with solids in suspension and molten materials.

Capacities of the "L" Type Pump range from 4.7 to 390.0 G.P.H.; pressures to 1,200 P.S.I. Other Hills-McCanna Pumps are available in capacities up to 1,500 G.P.H., pressures to 22,500 P.S.I.

Whatever your problems or requirements are, "Proportioning Pump Headquarters" will give you a speedy solution. HILLS-McCANNA COMPANY, Chicago 18, Illinois.

SEND FOR YOUR COPY of this new Hills-McCanna Catalog No. P-44. Liberally illustrated, it explains all pump applications and uses clearly.

HILLS-McCANNA COMPANY
2439 W. Nelson Street **Chicago 18, Illinois**

Air and Water Valves . . . Chemical Valves . . . Marine Valves . . Proportioning Pumps . . . Force Feed Lubricators . . . Magnesium Castings

PROPER LUBRICATION
—Your cheapest insurance against machinery breakdowns and war production slowups

Now that the nation's engines, motors, pumps, conveyors, air compressors and other machinery is running full tilt on victory production, good lubrication practice is doubly important.

Specific suggestions on lubricating methods that avoid "down time" for overhauling of industrial machinery will be found in the new "Recommendation Chart for Albany Lubricants." It covers more than 140 classes of equipment. Write today for your free copy.

ADAM COOK'S SONS, INC.
LINDEN, NEW JERSEY
Write for Free Chart→

ALBANY LUBRICATING PRODUCTS

EVERY BOILER
SHOULD HAVE ITS OWN . . . .
CAT'S-EYES

FOR BETTER COMBUSTION

THE BEST BOILERS ALSO USE
ESS HAZEGAGES or WYD-ANGLE PERISCOPES

ESS INSTRUMENT CO., FORT LEE, N. J.

Indicators, Controllers, and Recorders for Smoke Haze and Combustion . . . Specific Gravity . . . Turbidity Flame Failure . . . Industrial and Safety Applications

Pardon me for feeling pretty good about COAL

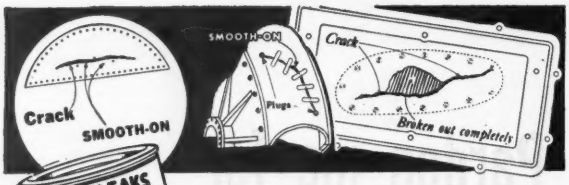
THAT'S a user of Champion Coal talking. We're operating shorter of manpower than we ever thought possible. We're finding maintenance and repair of mechanical equipment more of a problem every day. Yet, in spite of these and other difficulties, we're producing record tonnages, and—except for such recent contingencies as snowbound areas and car embargoes—*our commitments on Champion Coal have been kept.*

There's another and even more basic reason why Champion Coal users "feel pretty good." That's because Champion is always a *quality* product—a fine natural coal, mined by advanced methods and accurately cleaned and sized to suit your needs in huge modern preparation plants. You can depend on Champion in *every* way.

PITTSBURGH COAL COMPANY
Oliver Bldg., Pittsburgh, Pa.

A VITAL SOURCE OF HEAT, STEAM, POWER, AND RAW MATERIALS

Champion Coal



LOW-COST REPAIRS THAT *LAST*

A cracked oil base, repaired durably by filling the crack with Smooth-On No. 1 . . . leaking flanged connection, made vacuum-tight with Smooth-On No. 1 . . . burnt Diesel engine piston head; a cracked engine block; a burst valve body; a worn bearing . . . countless other emergencies around the plant are being met speedily and effectively with this widely used and fully known half-century-old Iron Repair Cement.

Smooth-On No. 1 general purpose cement, as well as the other special Smooth-On grades, are dependable stand-bys with engineers, mechanics, maintenance men. Your supply house has Smooth-On No. 1 in 7-oz. and larger sizes. Order a container today and keep it handy for emergency and routine repairs. If necessary order direct from our factory.

FREE ***The Repair Handbook Every Engineer Wants***

40 Pages. 170 Diagrams. Pocket size. Conveniently indexed. Clear, concise, practical, tested directions for countless metal repairs in plant, shop and home. Over 1,000,000 copies in use. Send coupon for *your* free copy.

1895-1945
Half a Century of Dependable Service

Mail This Today

Smooth-On Mfg. Co., Dept. 31,
570 Communipaw Ave., Jersey City 4, N. J.
Please send me my copy of the Smooth-On Repair Handbook.

Name.....

Address.....

3-45 .....

Do it with **SMOOTH-ON**
The Iron Repair Cement of 1000 Uses

MERCOID

DA
double adjustment.
Temperature or Pressure
AUTOMATIC CONTROLS

FOR HEATING, AIR CONDITIONING, REFRIGERATION AND VARIOUS INDUSTRIAL APPLICATIONS

Mercoid DA Controls have attained universal use throughout industry. They are adaptable to a wide range of applications and available in a variety of types to meet the demands for accurate control of temperature and pressure.

The distinctive features in Mercoid DA Controls are the corrosion and dust-proof mercury switch; the Bourdon tube actuating element, and the outside double adjustment, which makes it easy even for inexperienced workers to set the operating range of these controls. The direct reading eliminates calculations.

Complete information in catalog No. 600. Write for a copy.

THE MERCOID CORPORATION, 4235 W. Belmont Ave., Chicago, Ill.

Specify: FOR BETTER VISIBILITY

ERNST

HIGH and LOW Alarm
INCLINED
Water Columns
PRISMATIC REFLEX TYPE

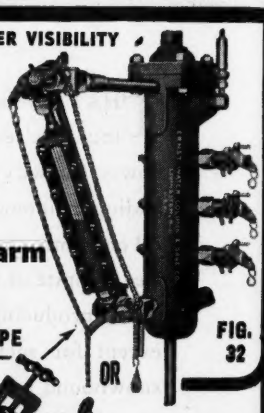


FIG. 32

OR

SPLIT GLAND TYPE

FIG. 1

Send for Catalog 45
TEL.: LIVINGSTON 6-2356

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, NEW JERSEY

TROY-ENGBERG

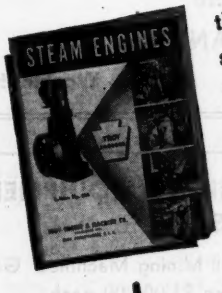
★ ★ ★

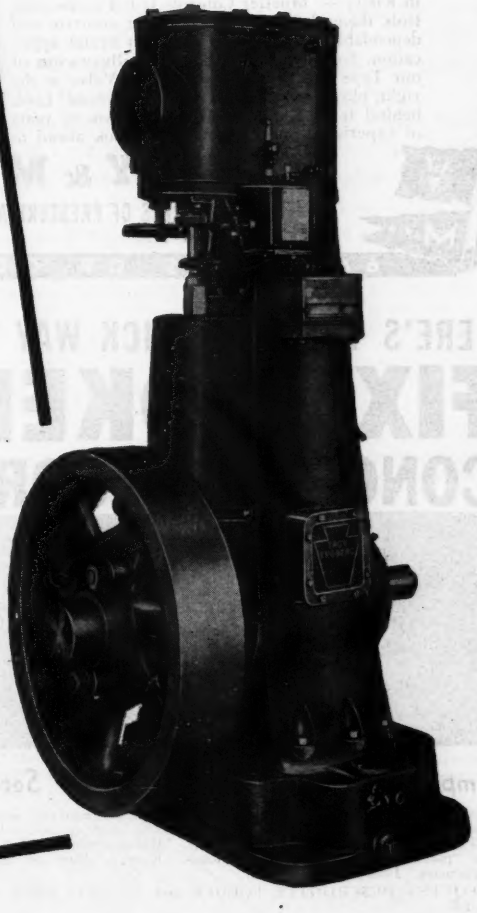
POWER That Soon Becomes Almost "Free" POWER

By "free" power, we mean that in a relatively short time the Troy-Engberg Steam Engine has completely paid for itself and from then on delivers power at so little cost as to be almost negligible. It can do this because it operates on steam intended primarily for processing or heating. It extracts the power and exhausts most of the heat units. It is what we call By-Product Power.

Low Cost By-Product Power has been responsible for placing the Troy-Engberg Steam Engine in thousands of plants driving stokers, pumps, compressors, fans, generators and other equipment. Why not investigate its possibilities for your plant?

Send for our New Bulletin No. 306



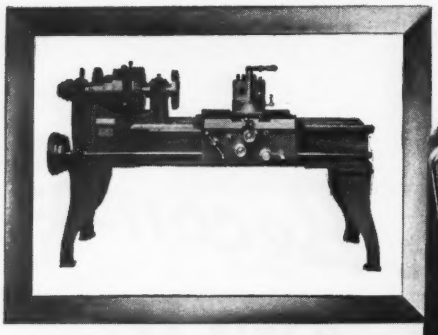


TROY ENGINE & MACHINE CO.

ESTABLISHED 1870

873 RAILROAD AVENUE, TROY, PENNSYLVANIA

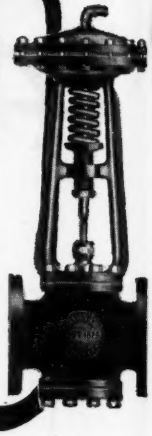
3-TEM-3



In 1878 the founders of The American Tool Works Company began the manufacture of lathes. At left is an 1890 model. Below is the famous American Pacemaker of today, as used in the Kieley & Mueller plant.

67 years of improvement...and "it comes out HERE"

Here? Yes, for the *real* advancement in lathe design is in the better, more accurate products those lathes make. Just as the real improvement in Kieley — Mueller Controls is not in the controls themselves . . . but in most accurate and dependable pressure regulation in actual application. So when you look at the illustration of our Type 418 Pressure Regulating Valve at the right, please look behind it . . . and *ahead!* Look behind it to Kieley & Mueller's own 66 years of experience and improvement. Look ahead to the long years of reliable performance Type 418 will give you on any standard service where inlet pressure, constant or varying, does not exceed 300 lbs. . . . and where reduced pressure range is from 1 lb. to 75% of inlet not exceeding 125 lbs. Type 418 is made in ½" to 12" sizes, single or double seated, with discs suitable for water, air, gas, oil, steam or corrosive fluids. Complete details and specifications in Catalog No. 66. Write for it.



KIELEY & MUELLER, INC.

MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879
2009 43rd ST. NORTH BERGEN, N. J.

66 YEARS OF CONTROL PROGRESS

HERE'S THE NEW QUICK WAY TO FIX BROKEN CONCRETE FLOORS

Tamp! Truck Over! No Wait for Setting!

Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty "patch." Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

REQUEST DESCRIPTIVE FOLDER and Details of FREE TRIAL OFFER.

INSTANT-USE

FLEXROCK COMPANY
3623 Filbert St., Philadelphia 4, Pa.

Please send me complete INSTANT-USE information and details of FREE TRIAL OFFER—no obligation.

Name .....
Company .....
Address .....

FOR SALE
Link-Belt Stoker No. 1250

Used only one year;
in perfect condition.

Write

BOZEMAN CANNING CO.

Mount Vernon **Washington**

SECOND HAND MINING EQUIPMENT FOR SALE

Five—35-A Jeffrey Shortwall Mining Machines. Good second hand condition. Price $1,000.00 each.

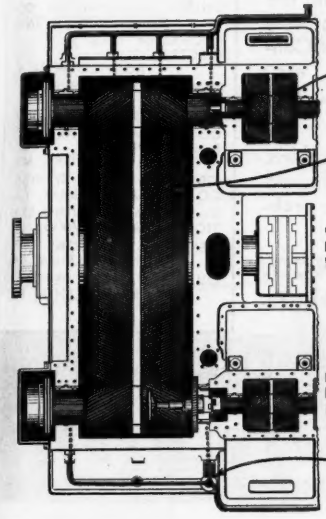
Five—Storage Battery Locomotives, without cells, 4 G.E. 6 ton, 30" gauge, one Westinghouse 7 ton, 28" gauge. Price $700.00 to $1,000.00 depending on condition.

If interested in any of above address reply to

THE HUDSON COAL COMPANY
Purchasing Department
424 WYOMING AVE. **SCRANTON 1, PA.**

STANDARD ENGINEERS NOTEBOOK

Compounded turbine oil stops rust damage


SPREADS EVENLY OVER BEARING AND GEAR SURFACES, LUBRICATES, RESISTS AND DISPERSES HEAT
WITHSTANDS GREAT OPERATING LOADS
CORROSION INHIBITOR RESISTS RUSTING IN PRESENCE OF MOISTURE, WHETHER SALT OR FRESH
PARTICULARLY VALUABLE IN PREVENTING RUSTING IN NEW INSTALLATIONS
OIL FROM CIRCULATING PUMP

When rusting is a problem in double reduction steam turbines, either because of sweating or leakage of fresh or salt water, Calol Deturbo Oil 19X is recommended. It eliminates the usual danger of rusting in new installations when first charged, and gives full protection throughout their lives.

Calol Deturbo Oil 19X is a compounded oil, made from selected crudes. It contains a highly effective rust inhibitor. In official tests, steel strips immersed in mixtures of Calol Deturbo Oil 19X and both fresh water and synthetic sea water showed no sign of rusting after 48 hours.

Because of its high film strength, Calol Deturbo Oil 19X carries the heavy weight imposed on turbine bearings, prevents wear and consequent rotor misalignment. It separates rapidly from water with a minimum of sludge formation, and is non-corrosive. Calol Deturbo Oil 19X fully meets U. S. Navy specification for 2190-T turbine oil.

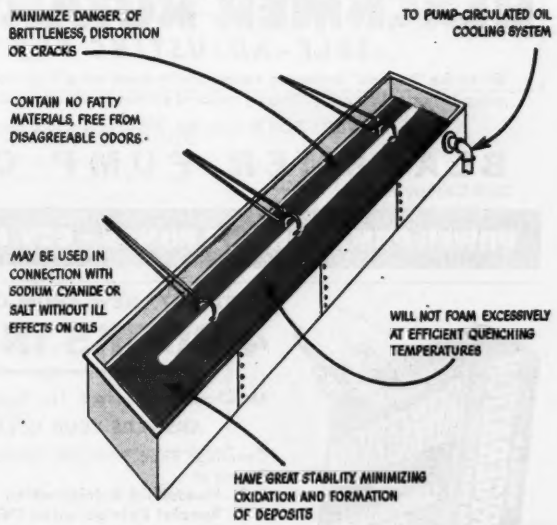
Quenching oils offer better hardness control

Because they retain their original viscosities on continued use, Standard's Calol Quenching Oils maintain a constant quenching speed and produce uniform hardness in steels. Viscosities are low enough so convection currents conduct heat away rapidly, but high enough to prevent excessive evaporation losses.

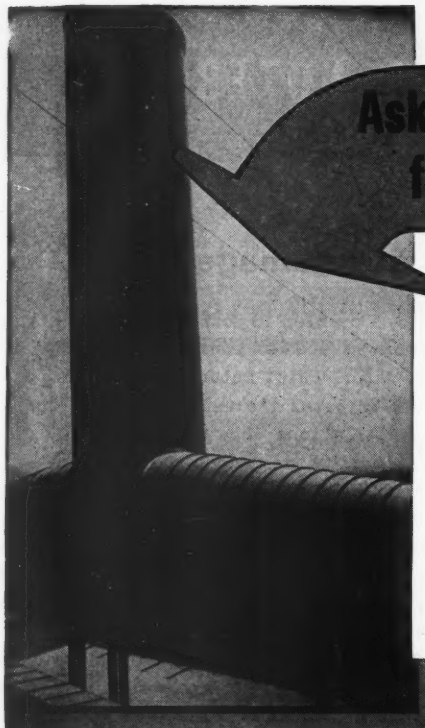
Calol Alloy Quenching Oil consistently produces higher hardness of alloy steels than ordinary quenching oils. Its outstanding cooling power is based on what is believed to be a new principle. Its use eliminates the chance of brittleness, distortion or cracks resulting from quenching with water.

Calol Quenching Oil, recommended for high-carbon steels, is made from a group of selected mineral oils covering a wide boiling range. They provide a moderate cooling-rate most desirable for these steels.

Both of these quenching oils have great stability, give off no disagreeable odors during use, and are not affected by sodium cyanide or salt.


MINIMIZE DANGER OF BRITTLENESS, DISTORTION OR CRACKS
TO PUMP-CIRCULATED OIL COOLING SYSTEM
CONTAIN NO FATTY MATERIALS, FREE FROM DISAGREEABLE ODORS
MAY BE USED IN CONNECTION WITH SODIUM CYANIDE OR SALT WITHOUT ILL EFFECTS ON OILS
WILL NOT FOAM EXCESSIVELY AT EFFICIENT QUENCHING TEMPERATURES
HAVE GREAT STABILITY MINIMIZING OXIDATION AND FORMATION OF DEPOSITS

STANDARD OF CALIFORNIA



Make Your Power Plant Building Dollars Buy Leakproof, Long-Lasting Construction . . .

Ask for a Connery Bid on those future Stacks or Breechings

WE take pardonable pride in the fact that 100% of Connery output is going to war production projects. And we feel certain that the many plants using (and planning to use) Connery's Improved Expansion Stiffened Construction for stacks, breechings, ducts, etc., won't mind if we give our best to "our first customer," Uncle Sam.

As government priority construction slackens, however, we will be in a position to offer old and new customers specific help on their problems of power plant construction.

CONNERY CONSTRUCTION CO.
Second and Luzerne Sts. Philadelphia, Pa.

Recent Installations

NEW HAMPSHIRE GAS & ELECTRIC CO. PORTSMOUTH, N. H.
UNITED ILLUMINATING CO. BRIDGEPORT, CONN.
ROCHESTER GAS AND ELECTRIC CO. ROCHESTER, N. Y.
INDIANAPOLIS POWER & LIGHT CO. INDIANAPOLIS, IND.
CONSOLIDATED GAS ELEC. & LIGHT PR. CO. BALTIMORE, MD.
VIRGINIA PUBLIC SERVICE CO. ALEXANDRIA, VA.
U. S. NAVAL TRAINING STATION GREAT LAKES, ILL.
HENRY DISSTON SONS PHILADELPHIA, PA.
QUARTERMASTERS DEPOT PHILADELPHIA, PA.

EXPANSION STIFFENED
CONNERY CONSTRUCTION

IF THESE OR SIMILAR LIQUIDS ARE HANDLED IN YOUR PLANT

Investigate

BLACKMER ROTARY PUMPS

SELF-ADJUSTING FOR WEAR

When the "buckets" (swinging vanes) finally wear out, a 20-minute replacement job restores the pump to normal capacity. Twenty years of service is not unusual.

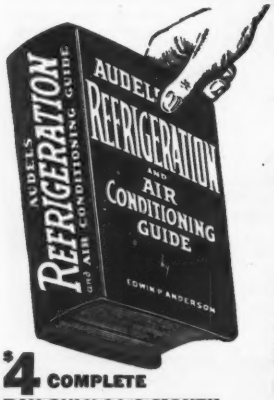
WRITE FOR Bulletin No. 306—Facts about Rotary Pumps.

BLACKMER PUMP COMPANY
2010 Century Avenue Grand Rapids 9, Mich.

POWER PUMPS - HAND PUMPS - EZY-KLEEN STRAINERS

Acids	Molasses
Alcohols	Oils
Asphalt	Paints
Beer	Rosin
Butane	Soaps
Dyes	Soups
Fuel Oil	Syrups
Gasoline	Tallow
Glue	Tar
Mash	Tomatoes
Mayonnaise	Yeast

JUST OUT! NEW FROM COVER TO COVER • 1280 PAGES • FULLY ILLUSTRATED



$4 COMPLETE
PAY ONLY $1 A MONTH

4 BOOKS IN ONE!

46 Chapters — Indexed for Ready Reference —

ANSWERS YOUR QUESTIONS

Covering: Basic Principles, Servicing, Operation, Repair of

1. **Household Refrigeration**
2. **Special Refrigeration Units**
3. **Commercial and Industrial Refrigeration**
4. **Air Conditioning Systems**

A gold mine of essential important facts for ENGINEERS, SERVICEMEN and USERS.

Here you have at your fingers' ends a Complete Library in ONE VOLUME, the necessary data you have been looking for on: MODERN UNITS, SYSTEMS AND MACHINES, REFRIGERANTS including Freon, Quick Freezing, Lockers, Water Coolers and Air Conditioning Systems.

AUDELS REFRIGERATION and AIR CONDITIONING GUIDE

ASK TO SEE IT!

To get this information for yourself, mail coupon today. No obligation unless satisfied.

AUDEL, Publishers, 49 W. 23rd St., New York 10, N. Y.
MAIL AUDELS NEW REFRIGERATION GUIDE for free examination. If O. K. I will send you $1 in 7 days; then remit $1 monthly until price of $4 is paid. Otherwise I will return it.

Name_____
Address_____
Occupation_____
Employed by_____ PPE

TRICKY TUBE CLEANING made easy-

FOR INSTANCE, SUPERHEATER TUBES of the return bend or hair-pin type. There is an Elliott cleaner for this, with a length of strong flexible shaft between the motor and the cutter head, which may be a threaded cone or a single-pin head. The motor does not have to go round the bend, which is cleaned halfway around from each straight portion of the tube.

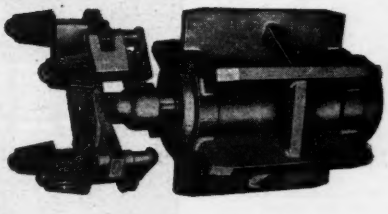
Here are just a few examples which serve to show the versatility of Elliott tube cleaners, and the alertness and ingenuity of Elliott engineers in devising methods that take the toughness out of tube cleaning.

Have you a ticklish or unusual job that calls for this kind of experience? Take it up with Tube Cleaning Headquarters.

ELLIOTT COMPANY
Tube Cleaner Dept., **SPRINGFIELD, OHIO**
DISTRICT OFFICES IN PRINCIPAL CITIES

TO CLEAN WATER-WALLS Not really a tricky job, as the cleaning of side-, floor-, and water-wall tubes is common procedure using the agile and powerful Elliott 1300 Series motor with universal joint and proper Elliott cutter head. This equipment has flexibility to reach two tubes through one hand-hole opening.

BIFURCATED TUBES, TOO can be difficult — but not with this special equipment, which includes a guide to direct the cleaner into either tube. The guide threads into the tube, and can be turned and locked in the desired position. A flat on the end of the unit indicates the direction of the guide.



LARGE TUBE AND PIPES Not a usual job around a power plant, but sometimes necessary as in new installations, to remove sand, mill scale or weld sputter from fabricated pipe. The picture shows a 4¾ in. motor with special sleeve for entering 10 in. pipe. Cutter heads are available up to 20 inches.

ONE-MAN CLEANER CONTROL In all tube cleaning, but on tricky jobs especially, it is easy to see how vitally helpful is the Elliott foot-throttle valve. This enables the man guiding the cleaner also to start it, speed it up, throttle it down, or stop it, all instantaneously. Works like the accelerator on an auto—and certainly accelerates any job of tube cleaning.

All the above developments, and many more, described in the new Elliott Book on Tube Cleaning —on request.

Y-235

ELLIOTT Company

STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS • FEEDWATER HEATERS AND DEAERATORS STEAM JET EJECTORS • CENTRIFUGAL BLOWERS TURBOCHARGERS FOR DIESEL ENGINES • TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

Are You Equipped to Hold Your Job?—to Get a New One?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

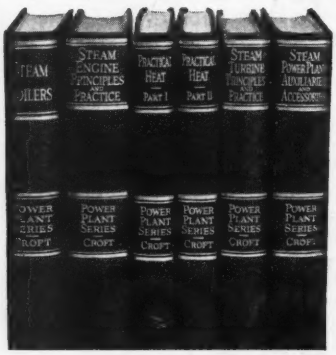
How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly, studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books?

Thousands of men have followed this plan to win advancement or to make their jobs safe. You can too. Read about this Library and our 10 Day Examination Offer. Then send the attached coupon to us today.

POWER PLANT PRACTICE

(6 volumes—2,477 pages, 2,404 illustrations)

The Library of Power Plant Practice is the standard of the power plant field. It is accurate—it is thorough—it is complete. It is the result of years of experience with power plant problems. The man who has it has the best. The Library covers the whole field — nothing is omitted. The solution of every problem is plainly worded or explained with a clear illustration. The little stickers and the big troublesome problems are all worked out in advance for you. There can be only one result from studying these books a few minutes each day—more money in your pocket.


STEAM BOILERS
STEAM ENGINE PRINCIPLES AND PRACTICE
PRACTICAL HEAT — PART I
PRACTICAL HEAT — PART II
STEAM TURBINE PRINCIPLES AND PRACTICE
STEAM POWER PLANT AUXILIARIES AND ACCESSORIES
POWER PLANT SERIES CROFT

No books dealing with the work of the power plant man were ever so complete — so authoritative — so practical in text and illustrations as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him, in language he can understand, all the information he needs in order to get ahead in his work.

Easy to Understand

These books are written in everyday easy-to-understand language. They are written to help the man on the job. It is just as if the author were working in the plant by your side and giving you the benefit of his vast knowledge, man to man. There's no bunkum in this Library, nor is it cluttered up with impractical theories. It is a **Power Plant Library FOR POWER PLANT MEN.**

Glance at the titles of the books in the photograph. They will give you an idea of how completely this Library covers **Power Plant Practice.** Here you have all the information necessary to make you indispensable on the job.

See it 10 days—Send no money

Fill in and mail the coupon below and we will send you the six volumes of the Power Plant Library for 10 days' Examination. If you decide to keep the books after examining them, just send $2.00 and then $2.00 a month until the total low price of $16.00 has been paid. See the coupon below for details. Send it Now and HOLD THAT JOB.

McGRAW-HILL ON-APPROVAL COUPON

McGRAW-HILL BOOK CO., INC., 330 West 42nd Street, New York

Ship to me, charges prepaid, the six volumes of the **Library of Power Plant Practice.** If satisfactory, I will send $2.00 in ten days and $2.00 a month until the price of $16.00 has been paid. If not wanted I will return the set to you postpaid.

Name .....

Home Address .....

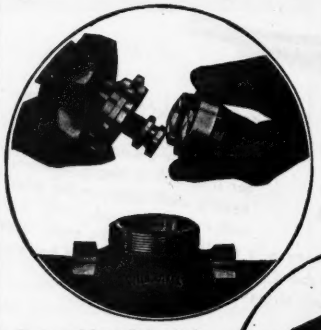
City and State.....

Company .....

Position .....PPE—3-45

Use VULCODISC

for trouble-free valve jobs

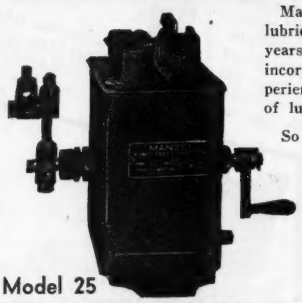


In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.
Write for descriptive bulletin.

THE D. T. WILLIAMS VALVE CO.
Cincinnati, Ohio

Insist on MANZEL LUBRICATORS



Model 25

Manzel Brothers have been building lubricating devices for nearly 50 years, and every Manzel lubricator incorporates the knowledge and experience gained in this long study of lubrication problems.

So be sure your engines, pumps and heavy machine tools are equipped with Manzel Lubricators. They are automatic, dependable and economical. There is a size and type to exactly fit your requirements.

MANZEL BROTHERS COMPANY, 327 Babcock St., Buffalo, 10, N. Y.

FOR SALE

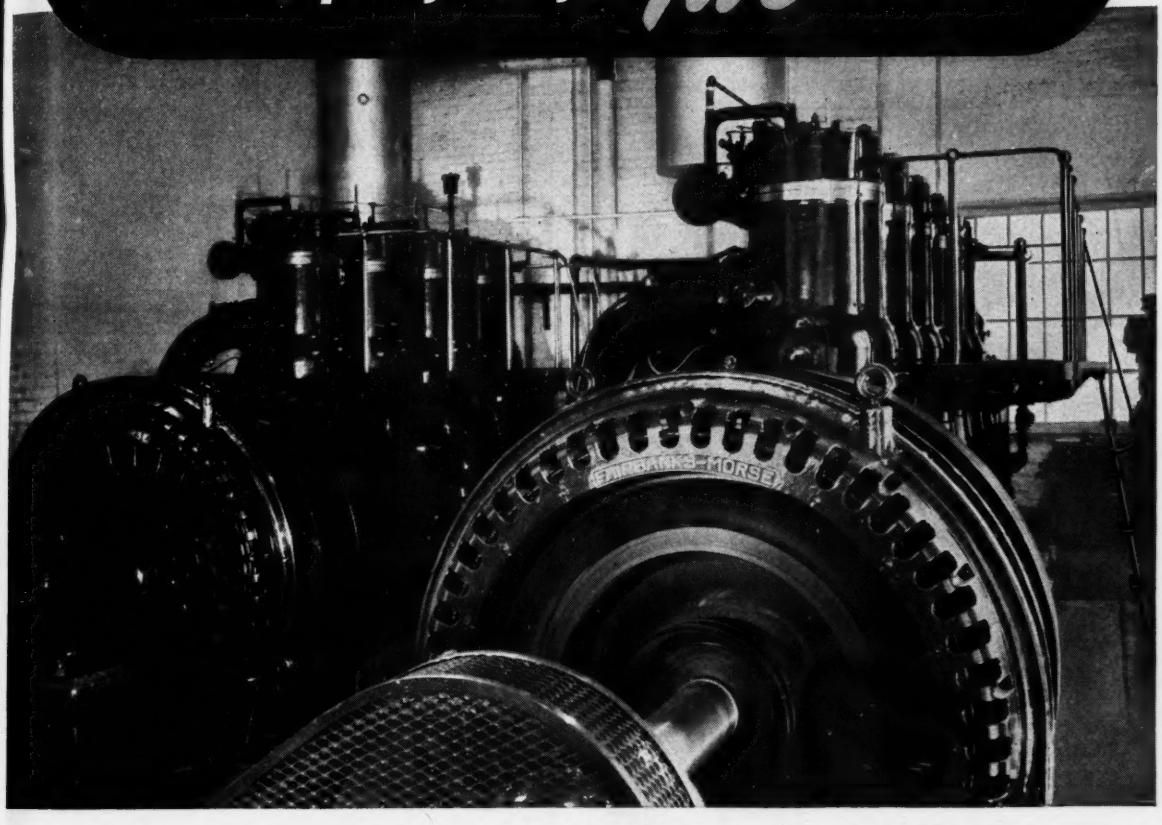
New and Reconditioned Iron and Steel VALVES

ALL TYPES AND SIZES
ALSO FITTINGS

Tested and Guaranteed

APEX IRON & METAL CO.
2204 S. Laflin St. Chicago 8, Ill.

Diesel Demonstrates $3,700 Saving – Company Buys *Two* More!



JUST one year of Diesel operation saved the makers of Valdura heavy-duty maintenance paints $3,700 in plant power costs. So, as expansion plans went into effect, two more Fairbanks-Morse Diesels went into operation.

This is a typical experience. Such performance is built into Fairbanks-Morse Diesels. They're designed for heavy duty, economical operation, low maintenance costs, and long life. And Fairbanks-Morse Generators are built the same way. Fairbanks-Morse power generating units are engineered before you get them. One maker is responsible, one guarantee covers them. For information on how you can save on power, write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

BUY MORE WAR BONDS

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps
Scales • Magnetos • Stokers • Railroad Motor Cars and Standpipes

DAVIS SOLENOID VALVES

offer

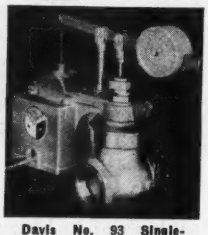
- Dia-Ball Transmission
- Steam, Air, Water and Oil Applications
- Extreme Accuracy
- Either Normally Open or Normally Closed
- Performance Proved by Years of Service
- Sizes ½" to 12"
- Pressures to 1500 lbs.

Davis No. 97 TH two-step Solenoid Valve. For proportioning or throttling of liquid flow. Extremely accurate.

The Davis COMPLETE line of Solenoid Valves has proved itself year after year by meeting all kinds of operating conditions in the automatic distant controlled valve field. Davis types of steam, air, water and oil valves adapted to solenoid operation include single seated valves for high or low pressures, balanced valves, butterfly valves and three- or four-way pilot valves. They are of the reciprocating or rotary stem type, and are made explosion proof when desired. The Davis Dia-Ball packless, leakproof transmission is also available on Davis solenoid valves. This construction is recommended for use with vacuum containers or when volatile or highly explosive liquids are handled.

The Davis Two-Step Solenoid Valve is designed to meet requirements of extreme accuracy.

There is a Davis Solenoid Valve to meet your specifications, whatever they may be. Write today for information!



Davis No. 93 Single-Seated Pilot-Stem Solenoid Valve.

Davis No. 380—a 3- or 4-way pilot valve.

Davis No. 93-H with Solenoid operated pilot valve and hydraulically actuated main valve.

DAVIS REGULATOR COMPANY
2508 S. WASHTENAW AVE.
CHICAGO 8, ILL.

DAVIS REGULATOR COMPANY

HOW MAGIC BOILER PRESERVATIVE

Guards 7 Ways Against Corrosion

Corrosion occurs when oxygen or acid gases act on metal. Oxygen and carbonic acid gas are found dissolved in all natural waters to a varying degree. Hydrochloric acid gas is formed under steaming conditions, when chlorides of iron, magnesium, calcium or sodium are present in feedwater. The liberation of hydrochloric acid gas from these substances is accelerated by the presence of sulfates of calcium and magnesium. Carbonic acid gas is liberated from bicarbonates of calcium and magnesium.

MAGIC Boiler Preservative acts in two ways to guard against corrosion. First, the MAGIC dissolved in the boiler water "binds" acid gases and represses their liberation. Second, the MAGIC film of protection keeps corroding substances from contact with the metal.

Write for Descriptive Bulletin.

GARRATT-CALLAHAN CO.
Established 1904

OF ILLINOIS
59 East Van Buren St
Chicago 5

OF NEW YORK, Inc.
1328 Broadway
New York City 1

OF CALIFORNIA
148-156 Spear St.
San Francisco 5

C. H. Wheeler of Philadelphia

STEAM CONDENSERS

•

STEAM EJECTOR TYPE VACUUM PUMPS

•

MECHANICAL DRAFT WATER COOLING TOWERS

•

DECK MACHINERY

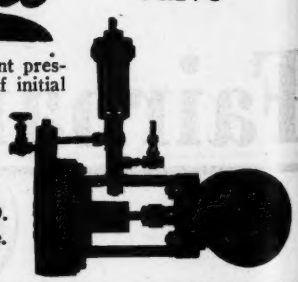
C. H. WHEELER MFG. CO.

19th ST. and LEHIGH AVENUE, PHILADELPHIA 32, PA.

Squires Reducing Valve

Will maintain the constant pressure desired regardless of initial pressure. It is a dead end valve.

May we send catalog E-10?



The C. E. SQUIRES CO.
E. 40th St. & Kelley Ave.
CLEVELAND, OHIO

"Union HB Long Pitch Engineering Chain is made in a complete range of strengths and sizes, with a wide variety of attachments."

HELP IN HANDLING MATERIALS

☆ The proper and efficient handling of materials throughout the processes of production calls for many types of conveyors. All have one common feature . . . their operation must be constant or production stops. That is why many conveying systems are built around Union Chains.

Union is not a manufacturer of conveyors, or for that matter, of any machinery. The Union organization is composed entirely of specialists in the manufacture of chain, chain attachments and sprockets. Consequently Union Chains and members of the Union organization have a reputation with customers for "wearing well." Engineering service is available to anyone confronted with the task of designing and building conveying equipment to "Help in Handling Materials."

The Union Chain and Manufacturing Company ..... Sandusky, Ohio, U. S. A.

Catalog A-2 covers Drive and Conveying Chain. B-2 covers Finished Steel Roller Chain. FC-1 covers Flexible Couplings. Ask for your copies.

Union Chains for Every Application

Drive and Conveying Chains and Sprockets

- Bridge Chain
- Combination Malleable Iron and Steel Chain
- HB (hardened bearing) type chain
- BP (bar and pin) type chain

★

Finished Steel Roller Chains and Sprockets

All manufacturer's standard sizes ⅛ in. to 2½ in. pitch
Single and Multiple Strands
Extended Pitch Series in sizes 1¼ in. to 4 in. pitch

★

Silent Chain and Sprockets

All sizes ¼ in. to 1½ in. pitch

★

Flexible Couplings

- Roller chain type
- Silent chain type

UNION CHAINS

ADSCO SEPARATORS and STRAINERS
for Marine and Industrial Service

KEEP YOUR STEAM LINES
Clean

Remove dirt, oil and water particles from the steam with *ADSCO Separators.* Made of semi-steel and fabricated steel, for low or high pressure lines, horizontal, vertical or special types.

Protect your meters, traps and other fixtures from sand, scale and other foreign matter with *ADSCO Strainers.* When in the market for T or Y Type Strainers and Macomb or special type strainers for low or high pressure service, send details of your strainer problem to ADSCO for recommendations and prices.

Other ADSCO Products include Expansion Joints for pipe lines, Condensation and Flow Meters, Tile Conduit for underground lines, etc.

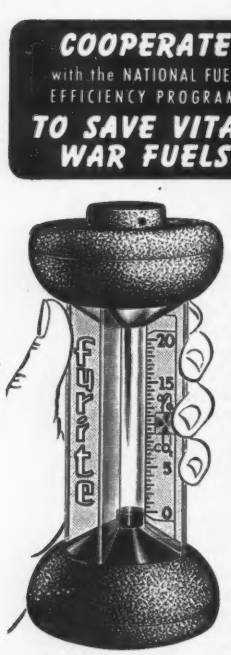
Write for ADSCO Catalog No. 35 E.

AMERICAN DISTRICT STEAM COMPANY
N. TONAWANDA, N. Y.
MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 65 YEARS.

COOPERATE with the NATIONAL FUEL EFFICIENCY PROGRAM
TO SAVE VITAL WAR FUELS

USE THE
PRACTICAL
FYRITE
CO_2 INDICATOR

REVEALS FUEL WASTE ***INSTANTLY!***



$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

BACHARACH
Industrial Instrument Co.
7000 BENNETT ST.
PITTSBURGH 8, PA.

CO_2 analysis of the flue gases is the only method available for determining the percentage of fuel wasted up the stack. The practical FYRITE CO_2 Indicator makes accurate flue gas tests easy—quickly pointing the way to adjustments and repairs necessary to secure efficient fuel utilization. The FYRITE requires no skill or technical knowledge; is simple and rugged; has no valves, clamps, or leveling bottle, no glass parts or batteries.

OXYGEN INDICATOR designed on same principle also available. Write for Leaflet 700.

RETURN THIS COUPON FOR BULLETIN 341 on FYRITE. *Learn how to get immediate delivery under priority regulations.*

Name _____

Address _____

City _____ State _____ PP

WANTED TO BUY FOR
ST. LUKE'S HOSPITAL, CHICAGO, ILLINOIS

CYLINDER COMPLETE WITH CYLINDER HEAD, PISTON & VALVES FOR 17 × 17 FLEMING 4-VALVE ENGINE MANUFACTURED BY HARRISBURG FOUNDRY AND MACHINE COMPANY
Length of Cylinder Casting: Flange to Flange 32 inches

Please reply to: Vern E. Alden, Engineers
120 South LaSalle Street
Chicago 3, Illinois

COAL STRIPPING CONTRACT WANTED

Experienced stripping contractor having, due to exhaustion of present mine, organization and equipment available, desires to produce strip coal and deliver on railroad cars or truck to plant storage pile for utility company or large industrial consumer, thereby insuring it low-cost dependable fuel supply. Will enter into long-term contract and furnish highest references.

Address Box 1468, Power Plant Engineering
53 W. Jackson Blvd., Chicago 2, Ill.

LET AMERICAN RING CRUSHERS HELP YOU

MAKE THE *Best* OF TODAY'S *Poorer* COALS

They reduce ROM coal to any desired degree of fineness in ONE operation

Today, as in the months ahead, many steam plant operators will need to make the best of the poorer-grade, hard-to-prepare coals which are available.

Scores of plants are finding in AMERICAN RING CRUSHERS the simplest answer to the problems of coal availability and grindability. Using the "AMERICAN" Way, they can reduce run-of-mine or lump coal to any desired degree of fineness—for stoker use or pulverized fuel firing—in one operation.

WRITE FOR *Free* Performance Data Book on Coal Crushing and Sizing.

Inside Story of the Splitting Action

These manganese steel Shredder Rings, a patented feature in "AMERICANS," shatter and distribute the coal before it reaches breaker and grinding plates. In contact with tramp metal, rings are deflected to avoid injury to machine.

Coal is split—not crushed—in "AMERICANS." Manganese Steel Shredder Rings, like the one shown above, split the coal and prevent clogging. Each ring has 20 cutting edges and is free to swing by centrifugal force.

Equally important, the grinding plate of the "AMERICAN" is adjustable, so that size of finished product can be varied. Adjustment can be made while the crusher is in operation.

Users report that the cost of coal crushing the "AMERICAN" Way is less than a penny a ton. This includes maintenance, power, labor, interest and depreciation.

Find out how your plant, too, can be assured against trouble in proper preparation of all grades of coal. Write for a free copy of new 8-page bulletin "Crushing Coal at Less Than One Cent a Ton."

AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis 10, Missouri

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

ADVERTISERS

Airetool Mfg. Co. *
Air Preheater Corp., The *
Alden, Engineers, Vern E. 220
Aldrich Pump Co., The 169
Allen-Sherman-Hoff Co. 6
Allis-Chalmers Mfg. Co. 18, 39, 67
Allpax Co., Inc., The 180
American Blower Corp. 29
American Chain & Cable Co., Inc. 137
American Chimney Corp. 194
American Coal Burner Co. 192
American District Steam Co. 220
American Engrg. Company 12-13
American Locomotive Co. (Alco Products Division) *
American Pulverizer Co. 221
American Radiator & Standard Sanitary Corp. 29
Anderson Co., The V. D. 186
Apex Iron & Metal Co. 216
Arkansas Fuel Oil Co. 67
Armstrong Machine Works 69
Atlas Lumnite Cement Co., The 177
Atlas Valve Co. 188
Audel & Co., Theo. 214

Babbitt Steam Specialty Co. 206
Babcock & Wilcox Co., The 58-59
Babcock & Wilcox Tube Co., The *
Bacharach Ind. Inst. Co. 220
Bailey Meter Co. 27
Baldwin-Hill Co. *
Baldwin Locomotive Works *
Beaumont Birch Company 194
Belmont Packing & Rubber Co., The *
Bendix Aviation Corp. *
Bernitz Furnace Appliance Co. 207
Betz, W. H. & L. D. *
Biddle Co., James G. 144
Bird-Archer Co., The 129
Blackmer Pump Co. 214
Bonney Forge & Tool Wks. 163
Bowser, Inc. 203
Bozeman Canning Co. 212
Breuer Electric Mfg. Co. 194
Brickseal Refractory Co. *
Bridegport Brass Co. 64
Briggs Clarifier Co. 179
Brunt Equipment Co. 160
Builders-Providence, Inc. *
Burgess-Manning Co. 131
Busch-Sulzer Bros. Diesel Engine Co. *

Canton Stoker Corp. *
Cash Co., A. W. 158
Certified Gauge and Instrument Corp. 146
Chapman Valve Mfg. Co., The Inside Back Cover
Chesterton Co., A. 160
Chicago Metal Hose Corp. *
Cities Service Oil Company 67
Cleaver-Brooks Co. *
Clipper Mfg. Co., The *
Cochrane Corporation 16, 136, 190
Combination Pump Valve Co. 188
Combustion Control Corp. 165
Combustion Engrg. Co., Inc. 22-23
Condenser Service & Engrg. Corp. *
Connery Construction Co. 214
Cook's Sons, Inc., Adam 208
Corning Glass Works *
Crane Co. 117
Crane Packing Co. 42
Crocker-Wheeler Division *
Cutler-Hammer, Inc. *

Dampney Company of America, The 167
Dart Mfg. Co., E. M. 152
Davis Engrg. Corp. 142
Davis Regulator Co. 218
Dearborn Chemical Co. 199
De Laval Separator Co., The 189
De Laval Steam Turbine Co. 50, 190
Detrick Co., M. H. 153
Detroit Stoker Co. *
Diamond Power Specialty Corp. 54-55
Dowell, Incorporated *

Edge Moor Iron Works, Inc. 161
Edward Valve Mfg. Co., Inc., The 115
Ehret Magnesia Mfg. Co. 53
Elgin Softener Corp. 141
Elliott Co. 2-3, 188, 215
Engineer Co., The 166
Ernst Water Column & Gage Co. 210
Ess Instrument Co. 208
Everlasting Valve Co. *

Fairbanks Co., The *
Fairbanks, Morse & Co. 217
Fairmont Coal Bureau *
Fischer & Porter Co. *
Fisher Governor Company 150
Flexitallic Gasket Co. *
Flexrock Co. 212
Flynn & Emrich Co. *
Foster Engrg. Company 155
Foster Wheeler Corp. 32-33
France Packing Co., The *
Fuller Company 156
Fyr-Feeder Spreader Stoker Div. 192

Garlock Packing Co., The 28
Garratt-Callahan Co. 218
General Coal Co. 172
General Electric Co. 20-21, 45, 175
Gifford-Wood Co. *
Globe Steel Tubes Co. *
Goetze Gasket & Packing Co., Inc. 51
Golden-Anderson Valve Specialty Co. 140
Greene, Tweed & Co. 184
Grinnell Co., Inc. *
Griscom-Russell Co., The 139
Grove Regulator Co. *

Haering & Co., Inc., D. W. 174
Hagen Corporation 46-47
Hall Laboratories 24-25
Hays Corporation, The 119
Hendy Iron Works, Joshua 149
Henszey Company 170
Hercules Float Works *
Hills-McCanna Co. 208
Honan Crane Corp. 182
Hudson Coal Co., The 212
Huyette Co., Inc., The Paul B. 168

Infilco, Incorporated *
Ingersoll-Rand Co. 40-41
International Boiler Works Co., The *
International Nickel Co., Inc., The 26
Iron Fireman Mfg. Co. 56-57

Jenkins Bros. *
Johns-Manville *

Kano Laboratories *
Keasbey & Mattison Co. 52
Keeler Co., E. *
Kellogg Co., The W. M. *
Kennedy Valve Mfg. Co., The 133
Kieley & Mueller 212

Ladish Drop Forge Co. 157
La Motte Chemical Prod. Co. 190
Leavitt Machine Co., The *
Leeds & Northrup Company *
Leslie Company 183
Link-Belt Co. 201
Liquidometer Corp., The 204
Lummus Co., The *
Lunkenheimer Co., The 113

Manzel Bros. Co. 216
Marley Company, Inc., The 60
Maxim Silencer Company, The 9
McAlear Manufacturing Company 173
McGraw-Hill Book Co., Inc. 200, 216
Mercoid Corp., The 210
Midwest Piping & Supply Co., Inc. 135
Miller Tool Sales, J. C. *
Murray Iron Works Co. 180

National Aluminate Corp. 196
National Boiler Protector Co. 186
National Valve & Mfg. Co. 147
Niagara Blower Co. *
Nicholson & Co., W. H. 192
Northern Equipment Co. 123
Norton Company 193
Nugent & Co., Inc., Wm. W. *

Oakite Products, Inc. 198
Ohio Injector Co., The *
Otis Elevator Company 66

Pennsylvania Crusher Co. 206
Permutit Co., The Back Cover
Philadelphia Gear Works 181
Phoenix Mfg. Co. *
Photoswitch, Inc. 165
Pipe & Tube Products, Inc. 148
Pittsburgh Coal Co. 209
Porter Co., Inc., H. K. *
Porter & Co., Inc., H. W. *
Powell Co., The Wm. 143
Powers Regulator Co., The 198
Pritchard & Co., J. F. 159
% Proportioneers, Inc. % *

Quaker Rubber Corporation 204
Quimby Pump Co., Inc. *

Raybestos-Manhattan, Inc. 62
Reading-Pratt & Cady Div. of American Chain & Cable Co., Inc. 137
Refinery Supply Co., Inc. 208
Reliance Gauge Column Co., The 38
Rempe Co. 194
Republic Flow Meters Co. 34
Richardson Scale Company *
Roto Company, The 178
R-S Products Corp. 164

Sarco Company, Inc. 19
Saverite Engrg. Co. *
Scovill Mfg. Co. 171
Schutte & Koerting Company 187
Sea-Ro Packing Co. *
Shell Oil Co., Inc. 61
Simplex Valve & Mfg. Co. 37
Sims Company, The *
Sinclair Refining Co. 43
Skinner Engine Co. 195
Smooth-On Mfg. Co. 210
Socony-Vacuum Oil Co., Inc. 17
Springfield Boiler Co. 65
Squires Co., The C. E. 218
Standard Oil Company of California 213
Standard Oil Company (Indiana) 35-36
Steel Improvement & Forge Co. *
Stephens-Adamson Mfg. Co. 53
Sterling Engine Co. 191
Stonhard Co. 202
Stout & Sons, David 185
Strong, Carlisle & Hammond *
Struthers Wells Corp. *
Sun Oil Company 125
Swartwount Co., The 190
Syntron Company *

Taylor & Co., W. A. *
Taylor Forge & Pipe Works 145
Templeton Brothers, Inc. 182
Terry Steam Turbine Co., The 14-15
Texas Co., The 4
Tide Water Associated Oil Co. 48-49
Titusville Iron Works Division, Struthers Wells Corp. *
Todd Shipyards Corporation (Combustion Equipment Division) *
Treasury Department 138
Troy Engine & Machine Co. 211
Tube-Turns, Inc. 127

Union Iron Works *
Union Asbestos & Rubber Co. 44
Union Chain & Mfg. Co., The 219
U. S. Gasket Co. 121
United States Rubber Co. *
United States Steel Corp. 177

Victor Products Corp. *
Viking Instruments, Inc. 192
Vogt Machine Co., Inc., Henry 151

Waldron Corp., John *
Wallace & Tierman Products, Inc. *
Warren Steam Pump Co., Inc. 68
Watson-Stillman Co., The *
Westinghouse Elec. & Mfg. Co. 30-31
Wheeler Mfg. Co., C. H. 218
Wickes Boiler Co., The *
Williams Gauge Co., The 154
Williams Valve Co., The D. T. 216
Wilson, Inc., Thos. C. 176
Wing Mfg. Co., L. J. *
Witte & Burden 204
Worthington Pump & Machy. Corp. 63

Xzit Sales Corp. 186

Yarnall-Waring Co. 10-11, 70, 162
Yoemans Bros. *

Zurn Mfg. Co., J. A. 205

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *

THE CHAPMAN PRODUCTION LINE IS CERTAINLY HUMMING THESE DAYS!
YES, AND EVERY VALVE THAT ROLLS OFF THE LINE STILL HAS THE SAME CHAPMAN "CUSTOM-MADE" QUALITY!
CHAPMAN 600 STEEL

Chapman Steel Valves roll off the production lines in greater quantities than ever before. Yet, every valve has a precision rating equal to that of a custom-made unit—meeting *or exceeding* standard specifications. All metals are developed and produced in the Chapman foundries under strict metallurgical control—a prime reason why Chapman Steel Valves stand up under severest war usages.

THE CHAPMAN VALVE
Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

Permutit protects plants against boiler-scale and corrosion!

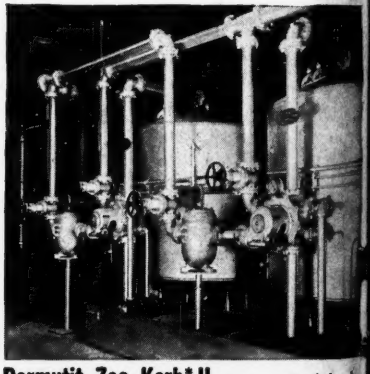
Today's heavy power output calls for full utilization of equipment. That's where Permutit helps!

Total solids in feedwater cause impaired operating efficiency, possible shutdowns for repairs to boilers and steam lines. Permutit reduces and removes such solids *before* the water enters the boilers.

Permutit is the world's largest manufacturer of water conditioning equipment. Permutit products include: Zeo-Karb* Water Conditioners, Hot and Cold Lime Soda Softeners, Spaulding Precipitators, Deaerating Heaters, Degasifiers, Silica Removal, Continuous Blowoff and Demineralizers that produce a low-cost substitute for evaporated water.

Let Permutit help *your* plant to keep up the good work! Write for information to The Permutit Co., Dept. A-1, 330 West 42nd Street, New York 18, N. Y. or Permutit Co. of Canada, Ltd., Montreal!

*Trademark Reg. U. S. Pat. Off.



Permutit Zeo-Karb* H removes both hardn bicarbonate from water. Effluent contains no tants, is reduced in total solids. Alkalinity adjusted by mixing effluents from a Zeo-Karb and a sodium zeolite unit.

PERMUTIT

GOOD WATER
for industry and
the armed forces

WATER CONDITIONING HEADQUARTERS